Global Nuclear Energy Partnership Siting Study

Final Report

The Central Savannah River Area Community Team

Energy Park
on the Savannah River Site

Financial Assistance Award
DE-FG07-07ID14794

April 30, 2007

Global Nuclear Energy Partnership Siting Study

An Energy Park on Savannah River Site

Section A – Executive Summary

The Central Savannah River Area Community Team (The CSRA Team) is pleased to submit this report in fulfillment of its requirements under DOE Financial Assistance Agreement DE-FG07-07ID14794. In that award, the Department of Energy (DOE) directed The CSRA Team to conduct its activities in two areas:

- Regulatory and Permitting: Identify local, regional, state and national regulatory and environmental permits required for this facility, including legislative or regulatory prohibitions that might prevent siting Global Nuclear Energy Partnership (GNEP) facilities in an Energy Park on the Savannah River Site (SRS), and
- Perform up to three informal community-involvement activities to inform state and local stakeholders of the purpose of the GNEP siting studies and obtain their opinions.

Both of these tasks have been successfully completed, and the results are contained in this final report.

Major findings and recommendations contained in this report are:

- **An Energy Park on Savannah River Site is ideally suited as the location of all three GNEP facilities**. SRS has been evaluated and determined to be acceptable for numerous DOE and NRC-licensed facilities. Its large land size, excellent geophysical characteristics, extensive and modern infrastructure, ample and reliable supplies of water, close proximity to GNEP markets (reactor fuel/recycle and electric customers), and strong community support make SRS the ideal location for the important GNEP facilities. These positive attributes are detailed in Section C of this report. Section D and Appendix 1 of this report contains descriptions of the SRS affected environment which, we believe, are in sufficient detail for direct incorporation into your GNEP Draft Programmatic Environmental Impact Statement (DPEIS).
- We have estimated the siting requirements for the maximally-sized Nuclear Fuel Recycling Center (NFRC) and Advanced Burner Reactor (ARR) and confirmed that **SRS capabilities can readily support the combined requirements of both facilities** (Section E)
- Using facility-specific assumptions, we have evaluated the requirements for permitting NFRC and ARR **as commercial facilities** in an Energy Park on SRS. With one exception (on-site decay storage), we believe that all required permits are within current SRS permit boundaries; and therefore **have a high degree of confidence that required permits can be secured for GNEP facilities.** Recent SRS experience in licensing the MOX facility with the NRC provides further confirmation of this belief. Commercial licensing with the NRC is the most stringent permitting situation (Sections G, H and I) and we have demonstrated this capability.
- The requirement for on-site 'decay storage' of 30 year half-life wastes may be an unknown commercial (NRC) permitting requirement. DOE ownership of these wastes can reduce this uncertainty (Section I).
- **Federal vs. commercial ownership of GNEP facilities** can affect the design, operation, and permitting for the NFRC and ARR. Items affected can include costs and radioactive waste management. Achievement of GNEP programmatic objectives may also be affected. Section J includes a brief discussion of some ownership considerations.
- **We have postulated an operating scenario for the GNEP program on SRS** which integrates GNEP facility requirements into SRS and regional capabilities, resulting in programmatic advantages and reduced costs. We believe this scenario to be particularly attractive in its use of surface and ground water. We offer this scenario (Section K) as one possible configuration to be evaluated in the DPEIS.

- We have reviewed local, regional, state, and national legislative and regulatory requirements for any prohibitions that might prevent siting the GNEP facilities in an Energy Park on SRS. **No such prohibitions or impediments have been identified** (Section L).
- We conducted three public involvement meetings to (1) inform the local public about the purposes and features of the GNEP program and (2) obtain comments and questions. The public has many unanswered questions about the GNEP program, and we have summarized the questions/concerns into 12 topical areas (Section M). **We suggest that DOE consider addressing these items in its DPEIS.**

It has been our pleasure working with DOE on this siting study and we hope our input will assist in the successful implementation of the GNEP program.

Section B – Purpose of Report

In August 2006, the Department of Energy sought applications from eligible entities to perform detailed siting studies of prospective locations to host one or both anticipated Global Nuclear Energy Partnership (GNEP) facilities. The Global Nuclear Energy Partnership is a comprehensive strategy to increase U.S. global energy security, reduce risk of nuclear proliferation, encourage clean energy development worldwide, and improve the environment. The Central Savannah River Area Community Team (CSRA Team) proposed siting both facilities at an Energy Park located on the Savannah River Site (SRS) near Aiken, South Carolina.

On January 30, 2007 the Economic Development Partnership was awarded Financial Assistance Agreement DE-FG07-07ID14794 on behalf of the CSRA Team. In its award, DOE directed that the CSRA Team conduct its activities in two areas:

- Regulatory and Permitting: Identify local, regional, state and national regulatory and environmental permits required for this facility, including legislative or regulatory prohibitions that might prevent siting such a facility, and
- Perform up to three informal community-involvement activities to inform state and local stakeholders of the purpose of the GNEP siting studies and obtain their opinions.

These activities have been completed and this report contains the results of our activities.

The data obtained and analyzed during this study demonstrate clearly that infrastructure and site characteristics of an Energy Park on SRS are very well suited for all GNEP facilities. The combination of the SRS, its infrastructure, and an Energy Park within the SRS provides DOE with unparalleled flexibility for meeting the GNEP objectives of constructing and operating full-scale the Nuclear Fuel Recycling Center (NFRC) and Advanced Recycling Reactor (ARR) facilities in a timely, cost effective, and environmentally safe manner. By siting GNEP facilities in an Energy Park DOE has the option to operate the facilities in either a DOE-owned or commercial-like structure. Major findings in the report include:

- An Energy Park on SRS exceeds DOE GNEP siting requirements for size, hydrology, electricity capability, population density, zoning, road access, seismic stability, and water access. GNEP facilities exceeding 3,000 MTU/year (NFRC) and 2,000 MWt (ARR) can be confidently sited.
- For many years SRS has constructed and operated nuclear reactors and fuel processing facilities on a scale larger than that proposed for the GNEP facilities. These existing programs and facilities have been successfully permitted by federal and state regulatory agencies, and provide a high degree of confidence that GNEP facilities can be readily permitted.
- The Nuclear Regulatory Commission (NRC) has reviewed a location in an Energy Park on SRS as the site for a commercial nuclear power plant. In addition, electric utilities have reviewed the same location for siting other nuclear power reactors. In all instances the proposed location met regulatory and operating requirements.
- The Savannah River Site is in close proximity to the GNEP customer base. Over one-half of U.S. reactors are within one day transport of SRS, thereby expediting shipment and receipt of spent nuclear fuel (SNF) and fresh fuel. In addition, there is a large and growing market in the southeast for electrical energy produced by the ARR reactor.
- There is a positive attitude toward nuclear energy in South Carolina and the areas surrounding SRS. State government is on record as supporting new nuclear power plants. The communities and citizens surrounding SRS strongly support DOE activities at SRS.
- GNEP facilities can make use of existing SRS infrastructure to reduce capital and operating costs and accelerate program schedule. Major items of potential interest include process water supply, sanitary water and sewer, railroad, environmental monitoring, emergency preparedness, medical, and technical support. Waste management, including radioactive

wastes, is another SRS capability which may be of considerable value to the success of the GNEP program. Facility ownership (federal vs. commercial) may influence the mechanisms for accessing SRS infrastructure and resources.

We have also included in this report a possible GNEP facilities operating scenario which will allow the GNEP program to take maximum advantage of SRS capabilities in the timely and cost effective conduct of development, construction, and operating activities.

This final report is organized as follows:

- Section C. Summary Description of SRS and an Energy Park
- Section D. The Affected Environment – The NEPA Description
- Section E. GNEP Facility Description and Siting Requirements
- Section F. Energy Park Siting Requirements
- Section G. Discussion of Existing SRS Regulatory and Permitting Situation
- Section H. Required New Regulatory and Environmental Permits
- Section I. Analysis of Required New Regulatory and Environmental Permits
- Section J. Analysis of DOE vs. Commercial ownership of GNEP facilities
- Section K. Potential GNEP Operating Scenario
- Section L. Identification and Discussion of State and Local Legislative and Regulatory Prohibitions with Potential Impact on GNEP facilities
- Section M. Summary of Community Involvement Activities

Section C – Summary Description of SRS and An Energy Park

This report defines the use of a private sector Energy Park located on SRS as the site for GNEP activities including the NFRC and ARR. An Energy Park is a key and unique part of this EDP proposal, offering significant benefits to DOE and to other GNEP-performing organizations.

An Energy Park will be located on lands wholly within the perimeter of the SRS which will be leased by DOE to a CRSA regional entity. Facilities within an Energy Park would be operated by commercial entities, federal entities, or private/public partnerships. By letter dated July 28, 2005, DOE has authorized discussions with entities regarding land lease arrangements at SRS. Negotiation of a Memorandum of Understanding which provides the basis for establishing a private sector Energy Park on SRS is currently underway and nearing completion. DOE's Savannah River Operations Office has provided a letter which indicates their concurrence in siting GNEP facilities in an Energy Park.

An Energy Park will be operated in a commercial environment and GNEP-performing organizations will be able to use and apply their commercial nuclear and other construction practices. Nuclear activities in an Energy Park will be subject to NRC requirements, thereby more closely achieving DOE's objectives for large-scale commercial demonstration of GNEP technologies and facilities. In addition to federal requirements, the licensing and permitting requirements for GNEP under the South Carolina Department of Health and Environmental Control have also been determined. An Energy Park will also allow DOE and commercial entities to capitalize on many positive SRS attributes which make it well suited for nuclear activities, including:

- A large contiguous secure land mass which offers a significant buffer between nuclear activities and the general public.
- Geology, hydrology and ecology which are well characterized and favorable to nuclear activities.
- A location in the midst of the fast growing southeast economic and population centers. The nation's nuclear renaissance is taking place in our region, and ample and growing markets exist for electrical energy produced by the ARR.

The infrastructure and site characteristics of an Energy Park are suitable for all GNEP facilities in a contiguous or dispersed arrangement. The combination of SRS, its infrastructure, and an Energy Park within the SRS provides DOE with unparalleled flexibility for meeting the GNEP objectives of constructing full-scale NFRC and ARR facilities in a timely, cost effective, and environmentally safe manner. Many existing SRS support facilities can be used during the construction and operation phases, thus, saving the expense of duplicating such facilities. The availability of highly qualified personnel in the region provides opportunities to use existing resources rather than training new personnel or obtaining contracted services which slow project execution. By locating the facilities in an Energy Park, DOE can take advantage of a commercial operating environment and the benefits resulting from an existing, full-scale, modern nuclear infrastructure on the SRS.

An Energy Park location and SRS have been previously evaluated for the siting of new nuclear facilities as discussed in **Table C-1**. These efforts are applicable to siting GNEP activities at an Energy Park location.

The proposed Energy Park site was found suitable for locating reactor-grade nuclear facilities under the July 2006 Draft EIS for an Early Site Permit at the Dominion North Anna ESP Site (NUREG-1811). An Energy Park site was also found suitable for DOE's Accelerator Production of Tritium Facilities (DOE/EIS-0270, March 1999).

Table C1 – Previous Regulatory and Permitting Efforts at Energy Park and SRS for New Nuclear Facilities

Facility	Reference
1. Reactor grade nuclear facilities (Energy Park)	Draft EIS for an Early Site Permit at the Dominion North Anna ESP Site (NUREG-1811), 2006.
2. Power production reactors (Energy Park)	NuStart Energy Development, LLC (2005); Dominion Energy consortium (2006); South Carolina Electric and Gas in partnership with Santee-Cooper (2006).
3. New Production Reactor (SRS)	Siting, Construction, and Operation of a New Production Reactor Capacity (DOE/DEIS-0144), 1991.
4. Accelerator Production of Tritium (SRS)	EIS Accelerator Production of Tritium at SRS (DOE/EIS-0270), 1999.
5. MOX Fabrication Facility (SRS)	EIS on the Construction and Operation of a MOX Fuel Fabrication facility at the SRS, Aiken, SC NUREG-1767, 2005.
6. Pit Disassembly and Conversion Facility (SRS)	DOE/EIS-0283, Surplus Plutonium Disposition
7. Waste Solidification Facility (SRS)	DOE/EIS-0283, Surplus Plutonium Disposition
8. Salt Waste Processing Facility (SRS)	SRS Salt Processing Final Supplemental EIS (DOE/EIS-0082), 2001.

Also, an Energy Park was recently evaluated as a location for one of the potential new power production reactors under the NuStart Energy Development, LLC consortium; by the Dominion Energy consortium; by South Carolina Electric and Gas in partnership with Santee-Cooper; and in two NRC visits to SRS. In all instances, the location was found to be suitable.

SRS has been considered and characterized for several large DOE missions and projects including the New Production Reactor. In addition, four major new facilities currently in design and scheduled for construction at SRS are the Mixed Oxide Fuel (MOX) Fabrication Facility (MFFF), the Pit Disassembly and Conversion Facility (PDCF), the Waste Solidification Facility (WSF), and the Salt Waste Processing Facility (SWPF). Construction of a new Tritium Extraction Facility was recently completed.

During the Early Site Permit (ESP) Process for North Anna alternative locations, four candidate sites: North Anna, Surry, Savannah River, and Portsmouth were identified as alternative sites. These four sites were further examined and evaluated to select the preferred site.

Each site was evaluated against 45 suitability criteria, and grouped into four major categories:

1. Environmental – Includes criteria (e.g., local population, groundwater, aquatic habitat and organisms) for assessing the potential adverse impacts of plant construction, operation, and decommissioning on the site, the surrounding environment, and the people.
2. Sociological – Includes criteria (e.g., socioeconomic benefits, present/planned land use, environmental justice) for assessing the potential impacts of plant construction, operation, and decommissioning on sociological issues.
3. Engineering – Includes regional, environmental, site, or other characteristics (e.g., cooling water source, site size, emergency planning requirements, site-specific seismic concerns, environmentally sensitive areas) that have the potential to impact the design, construction, operation, or decommissioning of a nuclear facility.
4. Economic – Includes criteria for assessing electricity and market projections, transmission line access, stakeholder support, and site development costs.

A ranking or score was assigned for each criterion. The sum of the weighted scores for all criteria is the total site merit score. In addition, a "bounding plant" was evaluated to establish a ranking score that would envelop the selected advanced reactor designs. A "site merit" score of 500 is the maximum that can be achieved for the "total site merit" of any criteria subgroup. Results show a narrow total score spread (i.e., ranging from 351 to 377) with the North Anna ESP site ranking highest. These results further indicate that all four sites are suitable locations for additional nuclear generating units.

Section D – The Affected Environment – The NEPA Description

This final report includes an updated description of the affected environment at SRS. This description is in a format and level of detail which should be sufficient for direct inclusion in the pending Draft Programmatic Environmental Impact Statement. The document “Description of Affected Environment – Savannah River Site” is included in **Attachment 1**, page 32.

Section E – GNEP Facility Description and Siting Requirements

As an international program, full-scale implementation of the GNEP strategy may involve several variations of nuclear fuel reprocessing and advanced reactor facilities. The GNEP program for the U.S., as currently defined by DOE, has not specified facility designs, quantities, or processes. The initial facilities proposed for the United States GNEP program are:

- A Nuclear Fuel Recycling Center (NFRC) - to separate the usable components contained in spent fuel from its waste products as well as fabricate actinide based fuel for the advanced recycling reactor
- An Advanced Recycling Reactor (ARR) - to burn the actinide based fuel to transform the actinides in a way that makes them easier to store as waste and produces electricity
- An Advanced Fuel Cycle Research Facility - to provide an R&D center of excellence for developing transmutation fuels and improving fuel cycle technology

The GNEP siting studies involve only the first two facilities, the NFRC and ARR.

The purpose of this section (E) is to provide general information on the GNEP facility assumptions used to support the assessment of siting requirements and capabilities. This detailed site report is promulgated on wide-ranging parameters for both process throughput and operational requirements. A discussion of the facility descriptions follows.

E.1 Limited Availability of Specific Facility Information

As the program is still early in the development phase (technologies have not been selected, and the size of the facilities have not yet determined), information detailed for the NFRC and ARR is for general discussion purposes only.

- Facility descriptions are based on DOE's program statements and some general knowledge from worldwide operating experience. This experience is based on available information for facilities using current available technology.
- It is assumed that the stringent NRC licensing guidance for new power reactors will envelope all siting, construction, and operating criteria for both the ARR and NFRC (the siting criteria for the MOX facility at SRS, performed under NRC guidelines, were very similar to current power reactor siting criteria).
- Private/commercial ownership of the NFRC and ARR facilities is assumed. If DOE ownership is adopted, some NFRC/ARR capabilities can be deleted and existing SRS infrastructure used.

Where it has been necessary to make additional assumptions about facility characteristics necessary for NEPA or siting evaluations, the additional assumptions are included in the facility description write-up.

E.2 Nuclear Fuel Recycling Center (NFRC)

The NFRC is an industrial facility that will treat and separate used fuel constituents into reusable and waste components. The NFRC will support two of the three key components of a used fuel recycling program:

- Separate light-water reactor SNF and fast reactor SNF into their reusable and non-reusable constituents. The UREX+ separation process is assumed.
- It will fabricate actinide/transuranic-based fuel for use in the destruction of transuranic elements in a fast reactor (the advanced recycling reactor). The process to fabricate ARR fuel has not been specified.

For the purposes of this report for siting the NFRC at an Energy Park on SRS, we have assumed the NFRC will be rated at 3,000 MT per year.

Taking into account the limitations cited in Section E.1, following are the main functions, modules, and process steps that could be envisioned for an NFRC.

- Fuel Receipt and Queuing – This module ensures safe receipt and handling of used fuel received from commercial nuclear power reactors.
- Shearing-Dissolution-Compaction – This module performs the front-end of the process by (1) shearing the used fuel bundles to provide access to the fertile material and (2) using dissolution liquors to remove the nuclear material present from the used fuel rods. The structural elements of the used fuel, such as end-fittings and cladding, are rinsed then compacted.
- Separation-Purification-Concentration – This building does the separation of the recovered nuclear materials into three separate process streams: (1) Uranium for recycling into fresh fuel for conventional reactors (2) transuranics/actinides for fabrication into a new fuel for use in Advanced Burner Reactors (with purification and concentration steps) and (3) conditioning of waste products into a stable form for storage and disposal (after a concentration step).
- Conversion and Fuel Production – This module converts the liquid stream of elements which will be used to produce new fuel for the ARR in an oxide or metal form. From there, the fuel is manufactured in the same building.
- High Level Waste Production – This sub-facility is where the high level waste stream is conditioned into a suitable matrix for permanent disposal.
- "Decay storage" waste – Sub-facilities to place 30 year half-life radioactive waste into a form suitable for 300 year storage and a storage facility suitable for storing this waste for 300 years.
- Low level radioactive, mixed waste, TRU wastes, and non-radioactive waste streams – These wastes will be treated into a form that is suitable for permanent disposal at another location.
- High Level Waste Cooling – Sub-facility to hold high level waste that needs to decay heat until it becomes suitable for acceptance to an optimal transportation path to a geological repository.
- Balance of Plant Facilities

These main functions, sub-facilities, and process steps would be placed in the most optimum and suitable configuration needed for the overall site.

DOE is currently evaluating alternative separations technologies and corresponding potential waste streams and alternative waste forms (e.g., borosilicate glass, ceramic). In addition, DOE is also analyzing SNF throughputs and corresponding facility size ranging from approximately 100 MT annually (engineering/demo scale), up to 3,000 MT annually (commercial scale). At the low range of throughputs, the analyses would correspond to engineering-scale capacities. At the high range of throughput, DOE expects that a nuclear fuel recycling center would have the capacity to recycle up to 2,000–3,000 MT annually, which would enable a nuclear fuel recycling center to recycle commercial SNF inventories that can decrease the current inventory of SNF (i.e., process annual commercial reactor SNF discharge plus work down existing inventory). Included in these evaluations will be studies related to queuing of SNF prior to recycling, as well as retention of waste generated from recycling, at a level related to the projected throughput for the facility.

An Energy Park at SRS is suitable for the maximum 3,000 MT/yr processing capacity for the NFRC. An expanded (or multiple) NFRC could be accommodated if required as sufficient seismically and environmentally qualified land is available. Processing water for the NFRC will depend on the final process selected, however, SRS can provide up to six million gallons per day from groundwater and/or an additional 20 million gallons per day from the river water supply system.

E.3 Advanced Recycling Reactor (ARR)

The ARR is a fast neutron spectrum reactor that will be capable of converting long-lived radioactive elements (e.g., plutonium and other transuranics) into shorter-lived radioactive elements with reduced total toxicity while producing electricity.

The DOE anticipates that the reactor used will be the Sodium-Cooled Fast Reactor (SFR) system that features a fast neutron spectrum and a closed fuel cycle for efficient management of actinides and conversion of fertile uranium.

Taking into account the lack of facility design data cited earlier, the main components of the ARR are envisioned to be:

- Reactor Building - contains the nuclear island and its associated auxiliary systems, along with the fuel component handling equipment, fuel decontamination facilities, and storage for new and used fuel. The reactor building will be designed to prevent the release of radioactivity and to provide radiological shielding.
- Steam Generator Building – contains steam generators.
- Auxiliary Building – contains nuclear island component cooling systems and the reactor building HVAC system.
- Turbine Generator Building – contains turbines and generators to produce electricity. The turbine generator building is connected to the steam generator building by feed water and main steam lines.
- Switchyard & Transmission lines – contains components to transfer electricity to the power grid.
- Auxiliary Building and balance of plant facilities.

The ARR will be designed for management of high-level wastes and, in particular, management of plutonium and other actinides. Important safety features of the system include a long thermal response time, a large margin to coolant boiling, a primary system that operates near atmospheric pressure, and intermediate sodium system between the radioactive sodium in the primary system and the water and steam in the power plant.

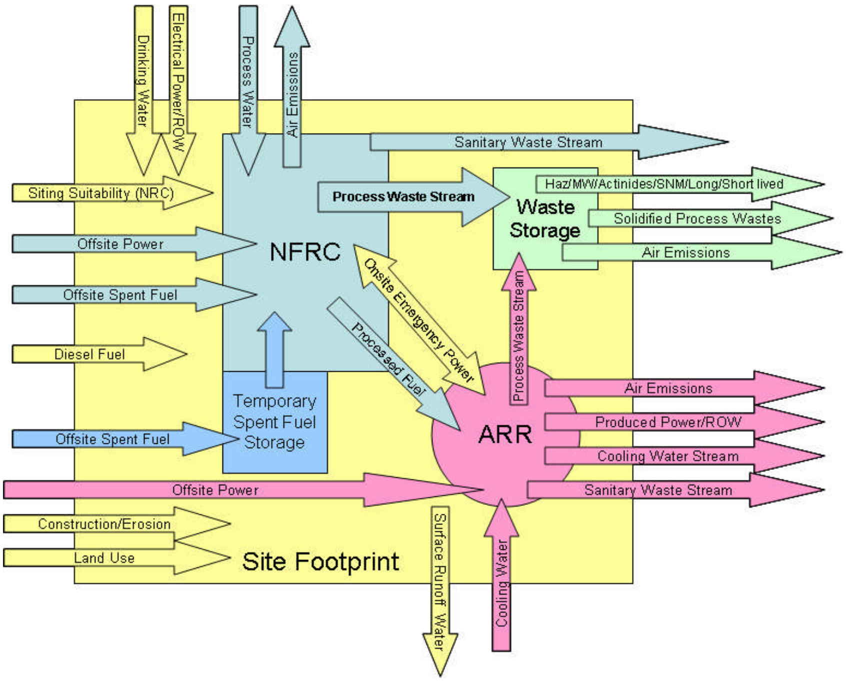
DOE is currently evaluating alternative fuel types (e.g., oxide, metal) and power ratings of 250—2,000 MWt (80 to 600 MWe). DOE also will assess appropriate alternatives for spent fuel generated by the reactor prior to future recycling, at a level related to the projected size of the reactor.

For the purposes of this report for siting the ARR at an Energy Park on SRS, we have assumed the ARR will be sized at 2,000 MWt. An Energy Park at SRS is suitable for more than one ARR operating at the maximum 2,000 MWt capacity. Sufficient seismically and environmentally qualified land is available for multiple power production reactors. An Energy Park site was found suitable as an alternative site for both the North Anna and NuStart commercial power reactors. Cooling water for the ARR will depend on the final design selected, however, SRS can provide up to six million gallons per day from groundwater and/or an additional 20 million gallons per day from the existing river water supply system. Existing and maintained cooling canals and lakes (heat sinks) exist at SRS with the capacity to support the ARR.

E.4 NFRC and ARR Block Flow Diagram

Figure E-1 provides a simplified diagram of the potential material flows into and potential releases from the facilities. This diagram provides the basis for identifying potential regulatory and permit requirements for the facilities.

Figure E-1 – Potential Material Flows into and Potential Releases from the Facilities.



E.5 DOE Minimum Site Criteria

In its financial assistance solicitation, DOE listed basic siting requirements for the GNEP study. An Energy Park on SRS exceeds all required criteria and is a fully qualified and suitable location for the GNEP activities, including the NFRC and ARR. DOE's basic siting requirements are reiterated below:

Size

A total in excess of 1,200 contiguous acres is available on SRS and in an Energy Park for siting both GNEP facilities, and the potential for expansion to 2,000+ acres exists.

Hydrology and 100-Year Flood Plain

The elevation of the site is 91 to 100 m (300 to 330 ft) above mean sea level. The SRS surface hydrology is well characterized and routinely monitored both by DOE and the U.S. Geological Survey. All of the acreage in the proposed site is above the 100 year flood plain.

Electrical Capacity

Both 115 and 230 kilovolt power transmission lines and a buried super-control and relay cable cross the proposed GNEP location. There is adequate power for construction and operation of GNEP facilities and routing of any produced power. The Right-of-Way for the existing power lines may be expanded for additional load capacity.

Population Density

Using the latest Census data, the population density, including weighted transient population, averaged over any radial distance out to 20 miles does not exceed 500 persons per square mile. The average population density in the counties surrounding the site is approximately 85 persons per square mile.

Zoning

The proposed GNEP site lies within the SRS and is wholly federally owned. Land for an Energy Park will be permitted to a CSRA regional entity for commercial heavy industrial use, and will be controlled by the permit with DOE. All minerals and subsurface rights belong to DOE. There are no environmental set-asides, remediation sites, cemeteries, endangered species areas, or other long term designated land withdrawal sites within an Energy Park.

Road Access

South Carolina State Highway 125 and U.S. Highway 278 are the primary public roadways transecting SRS. Both are two lane highways with routine commercial traffic. U.S. Highway 278 lies within four and a half miles of the proposed GNEP site and is capable of handling 80,000 pound gross vehicle weight traffic with adequate axle and wheel considerations. SRS is interlaced with public and DOE roadways which are maintained to support ongoing and future mission operations. An on-site heavy-duty construction access road originates at a barge dock on the Savannah River and terminates within two miles of an Energy Park. There is also rail access on SRS.

Section F – Energy Park Siting Requirements

There are minimal siting requirements associated directly with establishing an Energy Park on SRS. An Energy Park will consist of up to 2,000 acres of land (expandable), access roads to public highways, interior roads to individual sites, tie-in to commercial communication systems (telephone and fiber optic), sanitary water/sewer and electric power to an Energy Park substation. Communications, water/sewer and electric power will be sized to meet the "household" requirements for an estimated Energy Park population of 5,000 persons. Park tenants, such as GNEP, will provide the specialized infrastructure required for its specific processes.

The Department of Energy, Savannah River Operations Office has, by letters of August 31, 2006 and April 11, 2007 stated that it will make SRS lands available for an Energy Park to support GNEP facilities, including right-of-ways for transportation and utility corridors. DOE/SR has further stated that they will impose no requirement on GNEP activities located in an Energy Park other than adherence to the requirements of Federal, State and Local law and regulation.

DOE lease of lands for an Energy Park will be reviewed under the National Environmental Policy Act (most likely an Environmental Assessment). It is anticipated that the access road(s) to an Energy Park will require the most attention – potentially traversing wetlands and areas in proximity to rare and endangered species and cultural resources. These NEPA concerns will be mitigated by assessing alternate road corridors.

At DOE's option there are many opportunities to use existing SRS infrastructure for support of GNEP facilities in an Energy Park. Utilization of SRS infrastructure will require additional easements between an Energy Park and SRS for items such as access roads, utility corridors and a railroad spur.

Section G – Discussion of Existing SRS Regulatory and Permitting Situation

The Savannah River Site environmental program operates under an Environmental Management System (EMS) that conforms to all DOE federally mandated metrics. Additionally, SRS has been third-party certified to conform to International Standard (ISO) 14001 "Environmental Management System", Executive Order 13148, "Greening of Government Through Leadership in Environmental Management"; and DOE Order 450.1, "Environmental Protection Program."

For 2005, the latest compiled data available, SRS conforms to 417 different permits as shown in **Table G-1**. The number of permits varies during a calendar year with some closing and others opening.

Table G-1 – SRS Construction and Operating Permits, 2001-2005

Type of Permit	Number of Permits				
	2001	2002	2003	2004	2005
Air	172	150	2*	3	1
Army Corps of Engineers Nationwide Permit	5	5	5	3	4
Domestic Water	203	203	202	203	207
Industrial Wastewater	70	66	60	56	63
NPDES Discharge	1	1	1	1	1
NPDES No Discharge	1	1	1	1	0
NPDES Stormwater	2	2	2	2	2
RCRA	1	1	1	1	1
Sanitary Wastewater	133	133	109	104	106
SCDHEC 401	1	0	0	0	0
SCDHEC Navigable Waters	1	1	0	0	0
Solid Waste	4	2	3	4	4
Underground Injection Control	20	18	19	18	21
Underground Storage Tanks	7	7	7	7	7
Totals	**621**	**590**	**412**	**403**	**417**

It is the policy of the U.S. Department of Energy that all activities at SRS are carried out in full compliance with applicable federal, state, and local environmental laws and regulations. This will continue with all proposed GNEP activities operating under DOE and DOE/Commercial auspices, and will be the guideline for all commercial operations within SRS. Compliance with environmental regulations related to environmental protection is a critical part of the operations at SRS and will be so for GNEP facilities at SRS.

Current compliance activities at SRS include:

- Resource Conservation and Recovery Act (RCRA)
- Federal Facility Compliance Act (FFCA)
- Underground Storage Tank Program (UST)
- Liquid Radioactive Waste Tank Closure Program
- Waste Minimization/Pollution Prevention Program (WMin/P2)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- Emergency Planning and Community Right-to-Know Act (EPCRA)
- National Environmental Policy Act (NEPA)
- Safe Drinking Water Act (SDWA)
- Clean Water Act (CWA)
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
- Clean Air Act (CAA)
- Toxic Substances Control Act (TSCA)
- Endangered Species Act
- National Historic Preservation Act (NHPA)
- 10 CFR, Part 1022 (Compliance with Floodplains and Wetlands Environmental Review Requirements)

Section H – Required New Regulatory and Environmental Permits

Assuming the GNEP facilities will be operated as a commercial entity, it is conservative to estimate that all required permits will be issued as new applications rather than as modifications to existing SRS permits. All needed permits described in the sections above are considered likely to be required to insure similar compliance levels to those already existing at SRS. Minor exceptions are possible (for example, if GNEP chooses to use an extension of SRS's domestic and Sanitary Wastewater systems); however, these exceptions should not increase the difficulty of securing of permits. Using SRS domestic and sanitary permits is similar to new commercial and industrial parks "hooking on" to pre-existing community water and sewer systems.

H.1 Introduction

Permits needed for construction and operation of GNEP facilities are grouped as Air Permits, Water Permits, Waste Permits, and others. If GNEP facilities are built and operated by a commercial entity, most permits (and all major permits) would be secured by application for new permits. A listing of permits and their issuing agencies is detailed in Section H.2-H.5.

SRS's current operations already have mature permits that can be modified to accommodate new facility construction and operation. Construction and operation of the facility as a DOE-owned and DOE-operated facility greatly simplifies and streamlines permitting for air emissions, for water use and discharge, and for waste storage, treatment, and disposal. Modification of existing permits is generally faster and simpler than applying for new permits.

H.2 Air Permits

Air permits are required for construction and operation of new facilities that will have air emissions. The facilities air discharges themselves are subject to permitting, as is the construction of any air emission control equipment. Air permits are issued by the South Carolina Department of Health and Environmental Control. The National Emission Standards for Hazardous Air Pollutants (NESHAP) Radiological Air Emissions Permit Application and the New Source Review (NSR) Permit Application are both needed before construction can begin, and before air emission control equipment purchasing can begin. Both applications evolve into the sites Title V Operating Permit.

H.2.1 NESHAP – Radiological Air Emissions Permit Application

Directed by the Clean Air Act, EPA has delegated regulatory authority to SCDHEC for the release of radionuclides into the atmosphere from Department of Energy (DOE) facilities. A NESHAP – Radiological Emissions Evaluation must be performed for any new construction or modification of an existing source in which radioactive material will be present, handled, or stored. The results of the evaluation will determine if a NESHAP Radiological Air Emissions Permit Application to construct and operate is required.

The evaluation process is defined in 40 CFR 61 Subpart H and Appendix D. Evaluations are based upon the annual material throughput in the process (source term-inventory in curies), physical state of the material, control devices used for air effluent treatment, and the calculated effective dose equivalent (EDE) to the maximally exposed offsite individual using CAP-88 dispersion model. Both an estimated EDE and Potential EDE (PEDE) are determined in the evaluation. The PEDE is found as the emissions that would result from normal operations assuming control equipment is not present. If the estimated EDE is less than 1 percent of the 10 mrem DOE-Site standard (0.1 mrem), no approval is required (40 CFR 61.96). If the EDE determined from the evaluation exceeds 0.1 mrem, then a construction permit must be obtained from SCDHEC prior to construction or modification.

For unique situations, a user defined procedure for estimating the radionuclide emissions may be used in lieu of Appendix D, but only when prior approval from EPA-Region IV is obtained. The alternate procedure must be described and justified with the request.

H.2.2 NSR – Construction Permit Review

EPA has delegated regulatory authority to SCDHEC for the issuance of operating permits for new and existing air emission sources. Any plant which can be classified as a "major source" as defined in the Clean Air Act Amendments of 1990 must obtain a Title V Part 70 Operating Permit. This process incorporates New Source Review / Prevention of Significant Deterioration (NSR/PSD) approval process prior to construction. This process demonstrates that the proposed new or modified source will not adversely impact the air quality.

A NSR/PSD construction permit application or an exemption request must be obtained prior to the start of the project. This permitting process encompasses all sources that emit or has the potential to emit a regulated air pollutant, except those sources which are specifically exempted by the regulations. In some cases if the source of pollutants has a federal regulation which is applicable, i.e., New Source Performance Standard (NSPS) or National Emission Standards for Hazardous Air Pollutants (NESHAP), then the construction permit must be obtained prior to award of a contract.

The construction permit or exemption letter is obtained by submitting a permit application package or pertinent information to SCDHEC for their review and approval. SCDHEC has authorized WSRC to perform internally exemptions on selected insignificant sources, based on the quality and type of air emissions.

Placing a new or modified facility into operation following construction will be allowed under the conditions specified in the construction permit.

H.2.3 Background Documents

Local air shed data (other significant air sources within the area) and site specific data must be collected prior to the preparation of a New Source Review (NSR) permit application package. This information is dispersion modeling input data to determine potential impacts on the local air quality and ensure zero impacts to Class I Visibility Protected Federal Areas. This information includes the follow:

- Ambient air quality data - Available from SCDHEC BAQ
- Regional weather data – Available from SCDHEC BAQ
- Local (50km radius) source specific emission data from other industries
- Site specific emission data from the previous five years

H.2.4 Other Air Permitting and Operation Issues:

- Secondary, mobile, and short term sources, i.e. concrete batch plants or fugitive emissions during construction must be addressed in the permit application
- MACT standard for compression ignition (diesel) sources for emergency power
- Prevention of Accidental Releases 112 (r) for hazardous chemical storage
- Federal fleet vehicle requirements (low/no emission vehicles)

H.3 Water Permits

Water permits are needed for wastewater discharge and for wastewater treatment systems to be built and operated. The following SCDHEC water permits are required before construction:

- Permit to Construct Industrial Wastewater Treatment System
    - Evolves into Permit to Operate the System
- Permit to Discharge Wastewater
- Permit to discharge Stormwater from Industrial Area
- Sanitary Sewage/Domestic water permits

H.3.1 Water Permits – General

Under the Clean Water Act National Discharge Elimination System (NPDES) program, water resources are protected from the construction of the project though the discharges of industrial wastewaters during operation of the facility. This process begins with the NPDES Construction General Permit with coverage during the construction phase of the project. A Storm Water Pollution Prevention Plan (SWPPP) with the associated Grading Permit Application is required for all new projects involving land disturbances before any construction, expansion, or modification may begin. If the facility has an industrial wastewater treatment (IWT) plant, including industrial waste water and sewage, involved in the operation, then an IWT construction permit will have to be obtained before construction of that portion of the facility begins. Upon completion of the wastewater treatment facility, an operating permit will have to be issued before the IWT facility can begin operation.

Before the new facility is operational and discharging wastewater, an industrial NPDES permit has to be obtained. The facility has to identify the potential contaminants in its discharge and submit a permit application describing the discharge. SCDHEC will issue a NPDES industrial discharge permit with the discharge limits of the facility contaminants to the receiving stream. In addition to the industrial NPDES permit, the facility will have to obtain coverage under other NPDES general permits for industrial stormwater discharges and utility water discharges.

In order to have domestic water in a new facility, a construction permit has to be obtained before construction of the drinking water distribution system can begin. Once the system is completed, an operating permit is required prior to placing the domestic water distribution system into operation for temporary and permanent facilities.

H.3.2 Erosion Control Permits prior to earth-moving

Erosion Control Permits are required before tracts greater than 10 acres can be cleared for construction. SCDHEC has delegated permitting authority for Erosion Control Permits to WSRC.

H.3.3 Dredge and Fill Permits

Dredge and Fill Permits are needed if construction will impact wetlands. Site qualification should include examining the construction zone for presence of wetlands and endangered species habitat. These permits are not needed during site characterization, but are needed prior to construction.

In order to construct and operate a new industrial facility, the appropriate water related permits must be obtained from the State of South Carolina, which has delegated authority from EPA for Federal Clean Water Act regulations with the exception of Section 404 dredge and fill activities administered by US Army Corp of Engineers. These permits are for the protection of water resources from land-disturbing activities during construction of the facility, potential filling of waters of the United States and wetlands during siting the facility, construction and operation of industrial wastewater treatment facilities, industrial wastewater discharges related to the operation of the facility, sanitary sewer system, and drinking water for personnel.

During the siting of a new facility, if it impacts waters of the United States or wetlands a Section 404 - Dredge and Fill - permit will be required from the US Army Corp of Engineers before the facility can be constructed. A Section 401 Water Quality Certification must be obtained concurrently with the Section 404 permit. This certification is issued by SCDHEC. In the unlikely event that the construction of the facility impacts a navigable water of the State of South Carolina, a permit will have to be obtained from SCDHEC and will also be done concurrently with the 404 permit and the 401 Water Quality Certification.

H.3.4 Well Construction Permit

A Well Construction Permit is needed for any wells used for site characterization, water quality monitoring, or water production. None are expected to be needed through site qualification. These permits are issued by SCDHEC.

H.3.5 Surface Water Withdrawal Permits

Surface Water Withdrawal Permits are on hold, but are under consideration by the South Carolina legislature. Such permits may become required before facility construction would begin.

H.3.6 Spill Control plans (not needed until after construction)

Plans are produced by the facility, and are reviewed by SCDHEC.

H.3.7 Background Documents (in need of updating)

- Stream Flow Analysis
- 316 (a) and (b) study; fish impingement and entrainment studies;

These documents are needed to support permit application. Gathering data for them is appropriate during the site qualification.

H.4 Waste Permits

H.4.1 RCRA

A RCRA permit is needed before a GNEP facility can generate, treat, or store hazardous waste. RCRA permits are issued by SCDHEC. A facility can be exempted from needing RCRA permits only if its operation generates small volumes (<100kg per year) of hazardous waste. Facilities as large and complex as GNEP facilities are likely to need such a permit. If the facility is not DOE-owned and operated, the facility will have to apply for its own permit, which can be a long lead-time item.

If GNEP facilities are DOE-owned, a modification to SRS's existing permit can be used to add new facilities to the existing permit. SRS would prepare permit modifications as required. This permitting is not needed during site qualification.

It is possible that existing SRS facilities could be used with minor permit modifications to treat select types of hazardous wastes that can be treated in conventional wastewater treatment systems.

H.4.2 CERCLA

SRS is on the National Priority List and has an existing Federal Facility Agreement governing cleanup. Although only contaminated areas are in the "listing", SRS can be in the position to show facilities and areas are clean. A modification to the SRS Federal Facilities Agreement would be needed to clarify that the new facility is not part of the NPL listing.

An Environmental Baseline Survey (EBS) of the area for lease must be prepared and sent to both EPA and SCDHEC prior to lease. A notice must be sent months before the lease advising them of the proposal. Due to the liability provisions of CERCLA, even if the property was not leased or deeded, an EBS should be prepared to document the condition as protection for both the owner and operator of the facility. The EBS is not needed during site qualification, but is needed before construction begins.

H.4.3 Background Documents Related to Waste

If GNEP facilities are operated as separate from SRS, then they will need a separate RCRA permit for hazardous waste generation, storage, treatment, or disposal. If the facilities are part of SRS, then they will need to be added to the Solid Waste Management Units document, which is a compilation of SRS's waste sites and their known histories and contents.

Depending on wastes that would be produced by a facility, SRS's Site Treatment Plan could require modification as well to catalog the new waste streams and the site's plan to store, treat, and dispose of them.

Neither of these document revisions is needed during site qualification. Both would be needed prior to operation.

H.5 Other Background Documents

H.5.1 Environmental Baseline Survey

Preconstruction Environmental Baseline Survey needed for two separate reasons:

- DOE Order requiring baseline environmental conditions to be measured before construction; allows impacts of facility operation to be defined by comparison to pre-construction baseline
- CERCLA requires an environmental baseline survey to be done before any federal property can be transferred or leased. This baseline survey is required for properties that may have stored hazardous materials or petroleum products for one year or more. The survey is not needed as part of site qualification, but it must be completed at least 60 days prior to the lease or transfer becoming effective. In addition, notification must be made to EPA of the planned lease or transfer.

H.6 Potential NRC Regulatory Documents

The Savannah River Site is interested in hosting both the Advanced Recycling Reactor (ARR) and the Nuclear Fuel Recycle Center (NFRC). Due to the early stage of development for these facilities, assumption must be made regarding the facility ownership, regulatory authority, size, technology, infrastructure requirements, environmental releases, etc., There are three approaches that should be considered – DOE owned and regulated, DOE owned and NRC regulated, and commercial facilities with NRC regulation. The GNEP Funding Opportunity Assessment (FOA) stated that the facilities should be capable of being licensed by the NRC but did not say that they would be licensed by the NRC.

This discussion assumes a commercial construction and operation of the ARR and NFRC, therefore requiring NRC oversight, review, regulation, permitting and ultimate licensing. The GNEP grant process was for the compilation of a detailed site report. This discussion considers only those potential NRC regulations related to siting an ARR and NFRC at SRS. This compilation is not exhaustive but should include principal regulations and NRC positions to be considered for GNEP activities that will lead to NRC licensing.

The following assumptions are made:

- The ARR is a new design power production reactor and will fall under NRC nuclear power siting criteria primarily sourced by 10 CFR 20, 10 CFR 50, 10 CFR 51, 10 CFR 52, and 10 CFR 100.
- The NFRC is a new design nuclear recycling facility that will fall under NRC processing and materials storage criteria primarily sourced by 10 CFR 20, 10 CFR 30, 10 CFR 31, 10 CFR 32, 10 CFR 33, 10 CFR 50, 10 CFR 51, 10 CFR 70, 10 CFR 71, 10 CFR 74, 10 CFR 75, and 10 CFR 110.
- Depending on ultimate programmatic decisions, the primary regulation for licensing for the ARR is either 10 CFR Part 50 or 52; the NFRC is a production facility so licensed under 10 CFR 50, although 10 CFR Part 70 is probably more appropriate. It is assumed that the ARR will be a commercially viable facility with the ability to produce usable power to the grid.

Potentially applicable NRC siting regulations, guidance, review plans, positions letters and commercial guidance, including a listing of Title 10 Regulations of the CFR are listed in Appendix 3, page 70.

Section I – Analysis of Required New Regulatory and Environmental Permits

Under the assumption that GNEP facilities will be owned/operated by a commercial entity, it is conservative to estimate that all required permits will be issued as new applications rather than as modifications to existing SRS permits. All needed permits described in the sections above are considered likely to be required to insure similar compliance levels to those already existing at the SRS. Minor exceptions are possible (for example, if GNEP chooses to use an extension of SRS's domestic and Sanitary Wastewater systems). These exceptions should not increase the difficulty of securing permits. Using SRS domestic and sanitary permits is similar to new commercial and industrial parks "hooking on" to pre-existing community water and sewer systems.

For the ARR, all compliance requirements in NRC regulatory guidance are thought to be required including limited construction, potential early site permits, environmental reports, and combined operating licenses. The state and local emissions permits previously described will also be required.

For the NFRC, some NRC permits may be required, especially those that adhere to the guidance potentially called for in SECY-06-066, *Regulatory and Resource Implications of a Department of Energy Spent Nuclear Fuel Recycling Program,* dated March 22, 2006. The licensing and permitting of Special Nuclear Material storage may require approvals under 10 CFR Part 72. The NFRC will likely store and process RCRA regulated waste forms, therefore RCRA mandated permitting, as mentioned above and as currently exists at SRS, will likely be required.

The storage and handling of long-lived fission decay products that result from the GNEP program will require potential new guidance and regulations from NRC and possibly DOE. Potential restrictions on on-site waste storage and disposal practices, potential limitations on waste inventory allowed on site, and transportation and packaging of materials from the NFRC to the ARR will need to be evaluated. No specific regulation exists for these materials under commercial guidelines although 10 CFR Part 72 might address relative issues. Once the design and process is finalized for GNEP, the permitting requirements for by-product materials should be reviewed under existing regulations to see if new regulations might be needed.

The regulatory and permitting requirements for protection of wetlands and endangered species habitat within an Energy Park, and on the SRS, exist under state and federal programs. No new or specialized permits or regulations are necessary.

All needed permits described in Section G and H are considered likely to be issued. No legislative or regulatory prohibitions are known that would prevent construction of GNEP facilities at SRS. It is suggested that the regulatory and permitting approach to the MOX facilities is correlative to the GNEP facilities within an Energy Park at SRS.

Section J – Analysis of DOE vs. Commercial Ownership

Ownership of GNEP facilities can have an impact on the evaluation of siting criteria. Ownership or control by the federal government allows the potential for ready access to existing DOE infrastructure with construction and operating cost savings, thereby increasing the value of locating GNEP facilities on a DOE site. This advantage must be evaluated against the desire to operate the GNEP facilities in a 'near-commercial-like' business situation. Near-commercial operation can be achieved at either DOE or non-DOE locations.

There are three broad options for ownership of GNEP facilities: (1) public, (2) private commercial and (3) private not for profit. Included in these options are the establishments of public/private partnerships. There are many implications associated with the form of ownership, including capital and operating costs, schedule, and achievement of program objectives. All envisioned forms of ownership can be accommodated in an Energy Park on SRS. In all ownership cases, it is assumed that the facilities will be licensed by the NRC (note: The MOX facility on SRS is precedent for an NRC-licensed facility being owned by DOE, located on a DOE site and utilizing host site infrastructure). The following discussion addresses some of the more obvious implications that ownership structure can have on GNEP program activities.

<u>GNEP Program Objectives</u>: Part of the GNEP vision is that the NFRC and ARR, are commercial facilities which can be adopted directly and deployed by the commercial nuclear industry. Operating the NFRC and ARR in a commercial-like manner directly supports this objective. Commercial-like operation implies (1) private sector ownership and operation of the NFRC and ARR facilities and (2) operation in a 'stand-alone' mode with contracted support limited to that expected to be available at commercial nuclear sites.

<u>Radioactive Waste Treatment, Storage and Disposal</u>: Federal ownership of the GNEP facilities may potentially ease the treatment and storage of radioactive wastes.

If the GNEP facilities have federal ownership, all of the SRS waste treatment and disposal capabilities are available to support GNEP operations. To the extent that existing SRS capabilities are used to support GNEP activities, construction and operating cost savings will result.

Legislation and regulation place restrictions on DOE receipt of radioactive waste from non-federal government facilities/operators. Unless specific legislative provisions are enacted, radioactive waste from commercially owned GNEP facilities must be treated in the GNEP facilities and disposed using commercial facilities (low level and mixed waste) or the National Repository (high level waste). These wastes could not be transferred to SRS and utilize existing treatment and disposal facilities (e.g. low level waste burial ground, TRU treatment/packaging).

The GNEP facilities include a 'decay-storage' strategy for management and disposal of some radioactive wastes (wastes with 30 year half-life). Storage of these wastes for 10 half-lives with subsequent disposal as a low-level radioactive waste is being considered. Establishment and permitting of this storage capability may be difficult. An option may be for the GNEP owner to contract with DOE for storage services (title to waste remains with the commercial entity).

<u>Construction and Operating Costs</u>: There are three primary cost implications associated with the form of ownership for GNEP facilities:

- Private ownership may place the facilities on the local tax roles. However tax liability will probably be significantly mitigated by (1) negotiation of special tax rates and other state/local incentives and (2) the imputed value of basic infrastructure provided by others in an Energy Park

- Capital and operating costs for radioactive waste management will be lower with Federal ownership. GNEP facilities will be able to use existing SRS capabilities instead of constructing/operating their own.
- The cost of other contracted SRS services will be slightly higher if GNEP facilities are not federally owned (The DOE added factor for support to non-governmental entities). GNEP facility operators will make a business decision on (1) which services to provide in-house vs. contracted, and (2) contracting for SRS services vs. contracting with another vendor.

The purpose of this discussion is not to advocate any specific form of GNEP facility ownership, but rather to identify that ownership can be an item for consideration in structuring the national GNEP program.

Section K – Potential GNEP Operating Scenario

The CSRA Community Team proposes that the Department of Energy can achieve significant time and cost advantages and reduce technology risk by fully utilizing SRS capabilities in support of GNEP program objectives. The purpose of this section is to briefly describe how SRS capabilities can support all aspects of the GNEP program, development, construction and operations.

We envision that all three GNEP facilities be located at SRS.

- The Advanced Fuel Cycle Research Facility (AFRC) would be located on SRS, outside an Energy Park, as a traditional laboratory O&M contract activity.
- The Nuclear Fuel Recycling Center and the Advanced Recycling Reactor would be located in an Energy Park on SRS.

Developmental programs will benefit by locating the AFRC on SRS. An SRS strength is the reduction of design concepts into engineering practice, and this expertise will be required as ARR and NFRC technology is developed prior to construction and operation of the facilities. The availability of F Canyon (currently deactivated but capable of being restarted) and H Canyon (active) provide flexible facilities to (1) develop and test individual items of equipment and (2) test and prove large-scale integrated systems using radioactive wastes. This capability does not exist anywhere else in the DOE Complex.

Water resources are a critical environmental and public concern. SRS has a unique opportunity to provide process and cooling water for the ARR and NFRC with minimal impact on Savannah River water quality and water usage. Major features of the existing SRS reactor cooling water system as proposed for GNEP include:

- River water system. This system is within 8,000 feet of an Energy Park and has the capacity of pumping over 800,000 gallons per minute – sufficient for multiple ARR reactor units.
- Ample supplies of groundwater exist to supplement/replace requirements for water from the Savannah River. Current SRS ground water usage is 3.5 million gallons per day, down from a peak usage of 10.8 million gallons per day in the 1980s.
- Two reactor secondary water cooling ponds exist on SRS. The largest pond can operate in a recirculating mode, with overflow/discharge via surface streams to the Savannah River. The second cooling pond is a once-through with discharge to the Savannah River. The largest pond has capacity to cool water discharges from 5,000 MWt heat sources. An Energy Park can be tied into the cooling ponds allowing for water discharge with a minimum of evaporative losses.

By using this unique water management infrastructure, GNEP facilities can operate with little or no impact to the Savannah River. Water quality can be maintained and water losses will be minimized.

SRS is located in the fast-growing southeast, and in close proximity to the GNEP customer base. Over one-half of U. S. reactors are within one-day transport of SRS, facilitating receipt of SNF and shipment of fresh fuel.

Approximately 20 new nuclear power reactors are planned for the southeast region. Equal important is the large and growing demand for electrical energy in this region, resulting in a ready market for power output from the ARR. An Energy Park location is within 8 miles of an existing 230 kV transmission line substation and within 25 miles of an existing 500 kV transmission line substation. Rights of way capable of being upgraded currently exist between these regional transmission circuits and an Energy Park. Local utilities have indicated interest in either (1) obtaining an equity position or (2) establishing a purchase power agreement for nuclear plants located on SRS.

Other parts of this report have documented that SRS has experience and infrastructure to support construction and operation of GNEP facilities:

- SRS has experience in supporting large and complex construction activities. Its past experience-base includes over 6,000 construction personnel on-site performing multiple nuclear projects simultaneously. This level of activity is directly relatable to expected GNEP construction activity.
- There are many infrastructure programs which are available for use by the GNEP program. Use of existing capability will save both construction and operating funds. The following is an expanded listing of infrastructure of potential value to the GNEP program:
  - Established Energy Park 80,000 lb access road from Hwy 278 along existing SRS Road 2-1-1 ands E-2 (28000 feet, 8540 m).
  - Maintained commercial control corridor (1500 ft, 457 m) either side of an Energy Park access roadways.
  - Utilize 115Kv power line through energy park for site power supply. (exists on Energy Park site)
  - Developed upgradient well field in Cretaceous aquifers for freshwater supply for processing at NFRC and make-up water for ARR. There are existing regional test wells (3000 ft, 914 m)
  - Use site water supply system for domestic use water for NFRC and ARR. Tie in to S/Z areas along existing roadway. (8000 ft, 2440 m)
  - Use site sewer system for NFRC and ARR. Tie in to S/Z areas along existing roadway. (8000 ft, 2440 m)
  - Extend SRS rail line "Main Line" spur along Road E-2. (8000 ft, 2440 m)
  - Utilize existing geotechnical study from APT siting. (Existing reports)
  - Utilize existing monitoring wells from APT site and Clemson Hydro Site. (Existing, on Energy Park Site)
  - Utilize Hawthorn seismic station as local seismic monitoring station. (18,000 ft, 5486 m)
  - Energy Park site is upgradient from all existing groundwater plumes and contaminated soils and will not impact existing remediation and monitoring efforts. (9,000 ft, 2743 m)
  - Energy Park site is away from high security and NNSA areas. (10,000 ft, 3048 m)
  - Data from the H-Area Meteorological Tower can be used for siting and monitoring. (10,000 ft, 3048 m).
  - Potentially store waste canisters in glass waste storage building in space leased from DOE. Buildings are existing, NQA-1 qualified and seismically qualified. (9,000 ft, 2743 m)
  - Use existing C-Lab and SRNL radionuclide analytical capability for process testing. (15,000 ft, 4572 m)
  - Use existing SRNL and SREL environmental and ecological monitoring to insure clean operations and future funding for these operations.

In summary, the integration of GNEP program requirements with SRS and regional capabilities can result in the most efficient and timely accomplishment of GNEP program goals.

Section L – Identification and Discussion of State and Local Legislative and Regulatory Prohibitions with Potential Impact on GNEP facilities

As part of the work scope for the Financial Assistance award, the CSRA Community Team was tasked with "identify local, regional, state and national regulatory and environmental permits required for this facility, *including legislative or regulatory prohibitions that might prevent siting such a facility* (emphasis added):

- No impediments have been identified which would affect the siting of GNEP facilities in an Energy Park on SRS.

This Section L will describe Team activities to identify and assess legislative and regulatory prohibitions. Each item will be addressed in turn.

There are no <u>local</u> (County or Municipal) requirements which would affect locating GNEP facilities on SRS. SRS is federal property, and allowable activities and conditions for an Energy Park will be governed by the land use agreement issued by DOE. DOE has not imposed any requirements on the location of GNEP facilities in an Energy Park on SRS other than "meet the permitting and siting requirements under Federal, State and local laws and regulations."

Aiken County is a member of the <u>regional</u> Lower Savannah Council of Governments (LSCOG). LSCOG does not have any activities or requirements which will impact locating GNEP facilities on an Energy Park on SRS.

There are no known <u>national</u> legislative or regulatory requirements which would prohibit the siting of GNEP facilities in an Energy Park on SRS. Recent national activities to (1) license the construction and operation of the MOX facility and (2) the Early Site Permit at Dominion Electric's North Anna Site document this conclusion. In many instances, South Carolina regulatory agencies have been delegated responsibility for administering and enforcing federal regulatory requirements.

<u>South Carolina</u> regulatory agencies are also responsive to initiatives of State Government. State Government can, in some instances, impose additional requirements or conditions on activities conducted within South Carolina. The CSRA Team has reviewed legislation and policies enacted by South Carolina State Government and we have not identified any impediments which would affect the siting of GNEP facilities in an Energy Park on SRS. We used the following methodology in reaching this conclusion:

1. SRS personnel most familiar with existing South Carolina regulations and permit requirements were interviewed. These personnel were involved with actions to license the MOX facility
2. The following databases were researched using a "key word" search.
    - Legislative Branch (1975 to present)
        - Legislation introduced but not enacted
        - Enacted Resolutions
        - Resolutions introduced but not enacted
    - State Register (includes all new, proposed or amendments to state regulation and agency notices) (2000 to present)
    - Attorney General Opinions (1975 to present)
    - Administrative Law Judge Opinions (1994 to present)

3. Over 250 items were identified in the database search. A summary of each item was examined to determine if it could include any provision affecting (1) the siting of nuclear facilities in South Carolina or (2) the conduct of GNEP-like activities in South Carolina. A

total of five items (proposed legislation and resolutions) were identified for additional in-depth review:

- One bill and one concurrent resolution supporting the expansion of nuclear power in South Carolina (expansion of the V. C. Summer nuclear power plant) were enacted by the legislature in 2006.

- One bill to allow receipt of waste from outside the Atlantic Compact into the Barnwell Low-Level Radioactive Waste Facility was rejected in 2007. (South Carolina is a member of the Atlantic Compact). A primary consideration in the action was the amount of disposal space available at the facility, and that acceptance of out-of-compact waste would reduce storage space for compact members.

- One concurrent resolution supporting an enforceable agreement between South Carolina and the Department of Energy for the disposal of surplus plutonium shipped into the State was not acted upon in 2002

- One bill to reorganize a portion of state government, including portions responsible for in-state nuclear affairs, was determined to be not relevant to our review.

4. Telephone interviews were conducted with senior policy personnel in key State agencies with responsibility for South Carolina nuclear activities. The purpose of the contacts was to determine if there are any pending actions not yet codified in statutes, regulations of published guidance which could affect the siting of GNEP-type facilities in South Carolina. Personnel contacted stated that they are not aware of any pending activities which could be an impediment to siting the GNEP facilities at SRS.

5. The Governor of South Carolina has issued two letters (April and September, 2006) supporting SRS as the location for GNEP facilities.

Based on the above, we conclude there are no legislative or regulatory initiatives that would prohibit siting GNEP facilities in an Energy Park on the Savannah River Site.

Rather, we believe that the actions of South Carolina State Government demonstrate an understanding of the importance of nuclear activities to the State, and a desire to support future nuclear projects.

Section M – Summary of Community Involvement Activities

The Central Savannah River Area Community Team (The CSRA Team) held three public information meetings as part of its Global Nuclear Energy Partnership (GNEP) siting studies grant activity. The meetings were:

April 10, 2007	Columbia, South Carolina
April 11, 2007	Bluffton, South Carolina
April 12, 2007	Greenwood, South Carolina

A total of 35 persons attended the three meetings. Meeting attendees are estimated to be a mix of the general public (~15), local business/civic/government (~15) and public interest (~5) groups. With three exceptions, all persons were from the local area of the meeting. Three of the attendees had previously participated in the DOE GNEP NEPA scoping meeting held in North Augusta, SC on February 15, 2007.

Each meeting consisted of (1) an overview of the GNEP program, (2) a description of the GNEP Technical Facilities, (3) a discussion of Savannah River Site capabilities, (4) an opportunity to ask clarifying questions and (5) an opportunity for general comments. Each meeting lasted about three hours and involved many questions and much discussion. In response to specific questions and comments the CSRA Community Team provided answers or clarification as possible. In some instances, the additional information satisfied the request; in other instances questions or programmatic concerns remained. Most meeting participants were satisfied and appreciative of the opportunity for in-depth discussion.

A record was made of questions asked and comments made during the information meetings, and the public input has been categorized into the 12 broad topical areas identified below. In general, the questions asked and comments provided during the three meetings were thoughtful and relevant to the pending GNEP public interaction process. We believe that the questions and concerns are representative of those which will be asked during review of the GNEP Draft Programmatic Environmental Impact Statement (DPEIS), and we recommend that DOE consider including information/discussion of these items in the preparation of the DPEIS document. Topics recommended for inclusion in the DPEIS are:

Topic #1 - Shipment of Spent Nuclear Fuel

There were many questions about spent nuclear fuel shipments associated with GNEP. Questions included (1) how many shipments, (2) transportation modes, (3) transportation accidents and local response capability, (4) terrorism attacks, including improvised explosive devices and (5) financial risk to the taxpayer.

Topic # 2 – The National Repository

The relationship between Yucca Mountain and GNEP was discussed. Will GNEP proceed if Yucca Mountain has not been approved (or if a national repository is never operated)?

Topic #3 – Business Planning, Program Risk and Economic Uncertainty

There were several questions/comments about the financial aspects of the GNEP program. Some felt the development risk was high, and others stated that recycling will never be economic. A suggestion was made that the GNEP program should be funded from private, not government sources.

Topic #4 – Status of GNEP Technology and Technical Risk

There were several comments about the status of GNEP technology. Comments included (1) GNEP is a very complicated system and (2) the new Japanese plants have had trouble coming on-line

Topic #5 - Spent Nuclear Fuel Coming to South Carolina and Waste Produced by GNEP Facilities

Many meeting participants expressed concern about radioactive waste either (1) brought into South Carolina or (2) generated by the GNEP facilities. Many participants expressed a concern that GNEP will result in a net increase in radioactive waste remaining in South Carolina.

Topic #6 – Health Effects

There were several questions about the health effects of proposed GNEP nuclear facilities on plant workers and the general public. There were two specific references to the effect of tritium on fetuses (and that current EPA standards are too high). Many persons believe there is a link between nuclear facilities and higher rates of cancer.

Topic #7 – Non-Proliferation

There were several comments that plutonium produced in the GNEP fuel cycle could be used to make a nuclear weapon. In South Carolina, there is confusion between the MOX program and GNEP.

Topic #8 – Environmental Concerns

There were several questions about the potential impacts of SRS seismic activity on public safety. There was also a question about “leaking tanks” at SRS. Several participants believed that existing processing plants (La Hague and Sellafield) had poor environmental records.

Topic #9 – Water quality and Usage (Emphasis on the Savannah River)

There were 10 questions/comments about the current and future impact of GNEP facilities on the Savannah River - consumptive losses and water quality. Specific questions were asked about tritium in the river (water supply for City of Savannah, GA and Beaufort & Jasper Counties, SC.). One person noted that the river is reaching its assimilative capacity. Population in the Southeast is growing and there will be increased demands on surface waters.

Topic #10 – The GNEP International Program

There were many questions and much uncertainty as to how the international aspects of the GNEP program will be established and be implemented on a day-to-day basis.

Many persons commented that it is difficult to predict the future behavior of sovereign nations. What are the implications if today’s GNEP partner becomes tomorrow’s adversary? Is the “Global” part of GNEP sustainable?

There were also many questions about how each GNEP ‘provider nation’ will determine (or be assigned) to other nations for fuel supply and recycling services.

Topic #11 – GNEP Program Strategy

There is uncertainty and question concerning the basic structure of the GNEP program. Specific items identified include:

- Relationship and differences between GNEP and the US MOX (Surplus Plutonium Disposition) program
- Differences between GNEP and current reprocessing activities
- Desire for ‘quantification’ of GNEP’s benefit in reducing future greenhouse gasses

Topic #12 - General Program Comments

Discussion of role of nuclear energy in future energy mix vis-à-vis fossil and renewables. Several specific recommendations were made to use GNEP funds to develop solar, wind and conservation.

At the end of each meeting, participants were provided the opportunity for summary or concluding comments. Because many of their comments and questions were presented during the discussion phase of the meeting, only about one-half of the persons present chose to do so; with several supporting GNEP in South Carolina, several opposing the GNEP program (at any location) and many expressing residual concerns. Given the number and types of questions and comments raised during the meetings, the majority of the meeting participants should be categorized as "undecided" in their views toward GNEP. DOE and the CSRA Team have the opportunity to address many of their questions and comments as part of the DPEIS preparation and subsequent public hearings along with future stakeholder communication activities.

Attachment 1 – Description of Affected Environment – Savannah River Site

1.1.2 Site Characteristics

1.1.2.1 Affected Environment and Demography

1.1.2.1.1 Site Location and Description

The Savannah River Site is a 310-square miles Federal reservation located along the Savannah River in southwestern South Carolina (see **Figure A-1**). The site is approximately 25 miles southeast of Augusta, Georgia and 20 miles south of Aiken, South Carolina. SRS's original mission was the production of strategic radioactive isotopes in support of the national defense program. However, with the end of the Cold War, the site's primary mission changed to environmental cleanup and restoration. Following is a brief description of selected environmental components of SRS's affected environment, particularly as they relate to the proposed GNEP site.

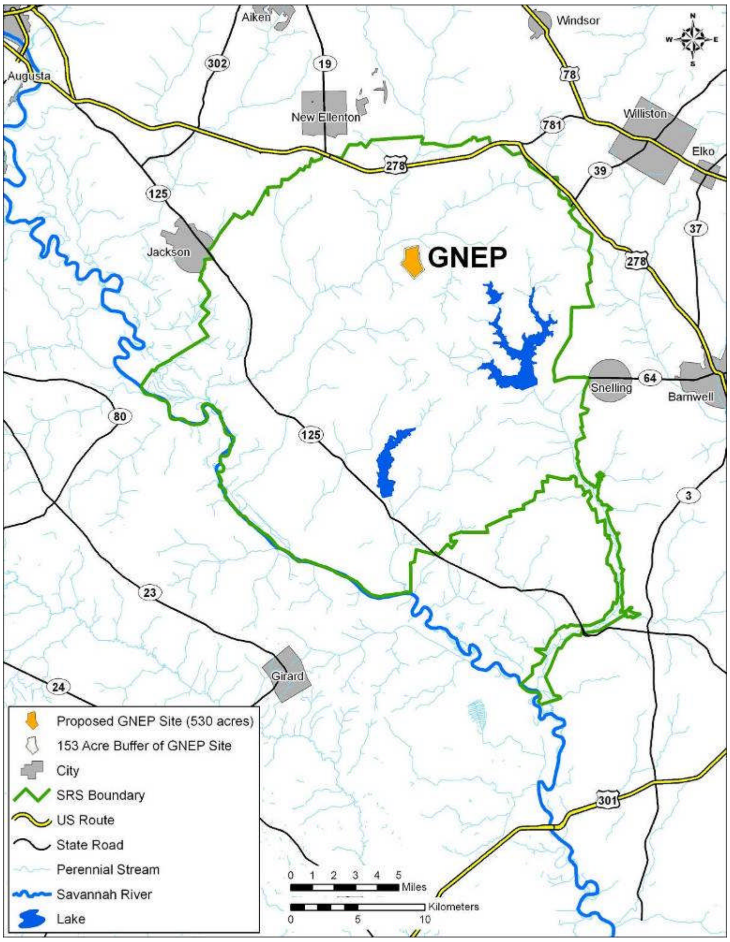


Figure A-1. *Outline of the Savannah River Suite with location of the Energy Park shown. The site is approximately 25 miles southeast of Augusta, Georgia and 20 miles south of Aiken, South Carolina. The outline of the site is approximately 600 acres with an additional 6-800 acres available surrounding the proposed GNEP facilities.*

Forestland (mostly southern pine plantation) is the dominant land use at SRS (approximately 80 percent of SRS land area), with the remainder consisting of aquatic habitats and developed landscapes (Wike et al. 2006). The developed landscapes consist primarily of roadways, administrative, and industrialized areas that are continually exposed to high levels of human activity and disturbance. The proposed GNEP site encompasses approximately 530 acres of undeveloped forestland located near the center of SRS. **Figures A-1** and **A-2** show the location of the proposed GNEP site within SRS and its dominant surface features (topography and nearby surface waters).

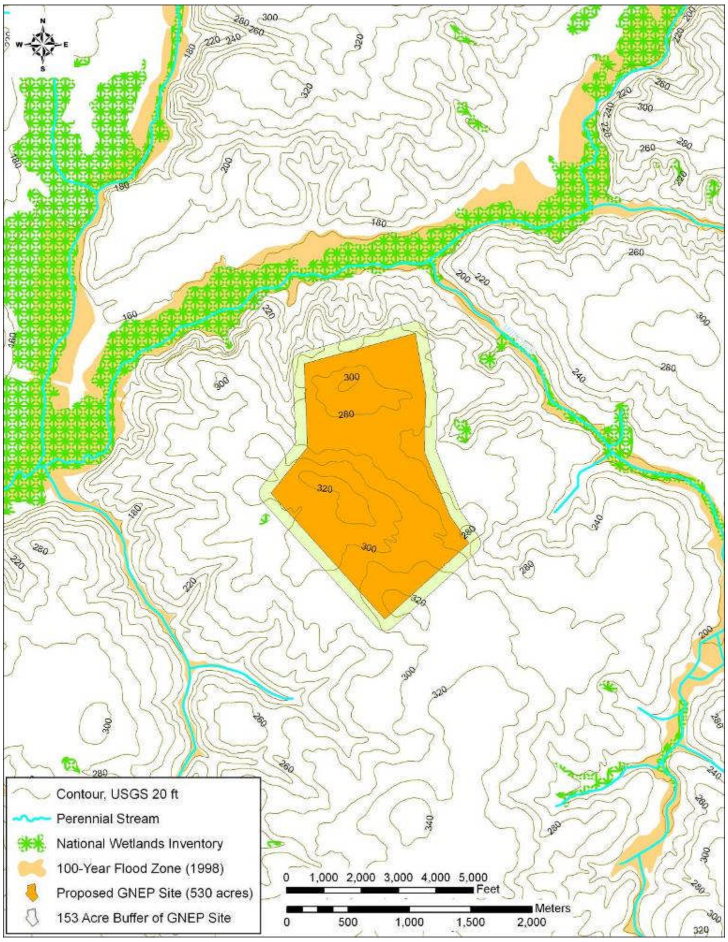


Figure A-2. *Contour map showing topography and the outline of the Energy Park with the surrounding buffer zone. The proposed site is located on a relatively flat, broad, and sandy upland area typical of the Aiken Plateau portion of the Savannah River Site. Streams, wetland, and the 100 year flood zone are also shown.*

Geology and Soils

The physiography of SRS is comprised of two major physiographic components: the Aiken Plateau and the alluvial terraces of the Savannah River. The Aiken Plateau is a dissected, sandy plain situated between the Savannah and Congaree rivers on the Upper Atlantic Coastal Plain of South Carolina. Its sandy sediments dominate the SRS landscape and range in elevation from 250 to 400 feet above mean sea level (msl). The alluvial terraces of the Savannah River occur below 250 msl.

The proposed GNEP site is located on a relatively flat, broad, and sandy upland area typical of the Aiken Plateau portion of the Savannah River Site (see **Figure A-2**) (Wike et al. 2006). Elevation across the GNEP site varies from 300 to 330 feet above msl (USGS 1987) with an average slope of less than four percent (Rogers 1990). To the north, west, and east, surface elevations drop rapidly from the upland area to the low-lying floodplains of contiguous surface streams (i.e., Mill Creek, McQueen Branch, and Tinker Creek).

The geology of the proposed GNEP site is typical of the SRS (Aadland et al. 1995). A hard crystalline bedrock lies approximately 960 feet below the surface of the proposed site (USDOE 1997). Above the bedrock are 11 geologic formations comprised of layers and mixtures of sandy clays and clayey sands, along with occasional beds of clays, silts, sands, gravels, and carbonate. In some cases, continuous clay layers act as confining units and restrict the upward or downward movement of groundwater below the proposed site.

Seven soil associations are represented within SRS (Rogers 1990). Generally, sandy soils occupy the uplands and ridges and are less fertile than the loamy-clayey soils of the stream terraces and floodplains.

The surface soils at the proposed GNEP site range from nearly level to sloping and well-drained, with a sandy surface and subsurface layer and a loamy subsoil. The Fuquay sand is the dominant soil mapping unit in the project area. In general, Fuquay sand is well suited as habitat for open land and woodland wildlife. DOE has evaluated the engineering properties of deeper soils in the immediate vicinity of the proposed GNEP site to a depth of 50 feet (WSRC 1991). In general, the soils from 0 to 50 feet range from silty sands to sandy clays with Atterberg liquid limit values in the range of 50 ± 10 percent. This indicates that these soils have moderate to high compressibility using mechanical compaction techniques during the preparation of deeper soils for supporting buildings and other structures. Standard Proctor values for these soils range from approximately 101 to 107 pounds per cubic foot at 17 to 22 percent moisture (Sowers and Sowers 1961).

Seismicity

A geophysical study of SRS has identified six subsurface faults: Pen Branch, Steel Creek, Advanced Tactical Training Area, Crackerneck, Ellenton, and Upper Three Runs. It is not believed that any of the SRS faults are capable (i.e., has moved at or near the ground's surface or was associated with another fault that has moved in the past 35,000 years). The actual faults do not reach the surface, stopping several hundred feet below grade. The closest subsurface fault to the proposed site is more than 0.5 mile away (WSRC 1996). This deeper bedrock fault does not cut through the overlying, unconsolidated surface sediments. Two major earthquakes have occurred within 100 miles of the SRS: (a) the Charleston, South Carolina earthquake of 1886 (estimated Richter scale magnitude of 6.8), and (b) the Union County, South Carolina earthquake of 1913 (estimated Richter scale magnitude of 6.0). In recent years, several small earthquakes have occurred within SRS: (a) June 8, 1985 (Richter scale magnitude of 2.6), (b) August 5, 1988 (Richter scale magnitude of 2.0), and (c) May 17,1997 (Richter scale magnitude of 2.3). The epicenters for these latter three earthquakes were more than 8 miles southwest of the proposed GNEP site (USDOE 1997).

Hydrolgeology

The depth to the top of the water table aquifer (Upper Three Runs Aquifer) beneath the proposed GNEP site ranges from 20 to 80 feet (USDOE 1997). Groundwater beneath the site follows the downslope surface topography and discharges into nearby surface streams (Tinker Creek and Mill Creek). Estimated flow rates for the water table aquifer range from 1.5 to 108 feet per year (WSRC 1991). The Gordon Aquifer, which is the first confined aquifer beneath the water table aquifer, lies between the Gordon and Crouch Branch Confining Units. In the immediate vicinity of the proposed site, flow within the Gordon Aquifer is predominantly lateral with a slight upward flow gradient (WSRC 1991). The Gordon Aquifer discharges, at least in part, to Tinker Creek and has an estimated flow rate of 13.8 feet per year (WSRC 1991). In the vicinity of the proposed site, the Gordon Aquifer receives water from overlying and underlying units (USDOE 1997). The regional-scale direction of Gordon Aquifer flow at the SRS (i.e., the overall flow of the aquifer across the Site) is toward the Savannah River. The deeper confined aquifers beneath the proposed GNEP site flow southwest toward discharge zones in the vicinity of the Savannah River. Hydrogeologic investigations indicate that the deeper aquifers have an upward flow gradient resulting in the potential for groundwater flow from deeper to shallower aquifers (WSRC 1991).

The groundwater at the proposed GNEP site has no detectable or only minor concentrations of organic compounds. Inorganic constituents (e.g., metals, chlorine, fluorine, nitrogen, sulfate) occur within the range expected for regional aquifers. Radiological analyses of groundwater from the water table aquifer indicate that gross alpha, nonvolatile beta, total radium, and tritium are present in some locations beneath the proposed site at, or slightly above, their respective drinking water standards.

Air Quality

The SRS (including Aiken and Barnwell counties in South Carolina) is located in the Aiken-Augusta Interstate Air Quality Control Region (AQCR). Sources of nonradiological air pollutants at the SRS are regulated by South Carolina Department of Health and Environmental Control (SCDHEC). Operating permits are issued by SCDHEC in accordance with various South Carolina air pollution control regulations and standards. All counties in the SRS region are currently in attainment of the National Ambient Air Quality Standards (NAAQS) for the criteria pollutants - sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, particulate matter (both 10 and 2.5 micron diameter particle size), and lead (SCDHEC 2006). In 2002, SCDHEC established formal agreements with all counties in South Carolina in the vicinity of the SRS to form Early Action Compacts (EACs) for ozone. The intent of the EACs is to develop and implement integrated regional strategies for limiting emissions of the precursor pollutants for ozone. Such strategies are believed necessary to ensure continued attainment of the standard within the Aiken-Augusta AQCR and to achieve compliance with the standard in adjacent areas, such as portions of Richland and Lexington counties (metropolitan Columbia, SC), that are currently classified nonattainment (SCDHEC 2006). Monitoring data in the Georgia counties of the Aiken-Augusta AQCR have indicated a potential for exceeding the revised NAAQS annual standard for PM-2.5. As a result, parts of the region, including a portion of Aiken County, may be redesignated unclassifiable for PM-2.5 in the future.

South Carolina Air Pollution Regulation 62.5, Standard 8, establishes ambient standards for 256 toxic air pollutants. Compliance with Standard 8 is assessed with respect to the maximum 24-hour average concentration that occurs along the facility boundary over an annual period. Results of the most recent regulatory compliance modeling required under Clean Air Act Title V for SRS emissions show ambient site boundary concentrations are well below the ambient standards (Hunter 2001).

Increased air pollution potential in the SRS area is frequently associated with stagnating anticyclones (high pressure systems). According to routine radiosonde (upper air) data summarized by Holzworth (1972), episodes of poor dispersion conditions in the SRS area lasted for two days on twelve occasions over a 5-year period (1960-1964). Episodes lasting at least five days occurred on two occasions. An episode is defined by mixing heights less than 5,000 feet (1,525 m) and average boundary layer wind speeds less than 9 mph (14.5 km/h). Results of a study reported by Korshover (1975) indicate that an average of two air stagnation episodes occurred in the SRS area each year over the 40-year period from 1936 to 1975. The total number of stagnation days averaged about 10 per year. Korshover defined stagnation days as conditions characterized by limited dispersion lasting four days or more.

Aquatic and Terrestrial Ecology

Since 1951, when the U.S. Government acquired SRS, natural resource management practices and natural succession outside of the developed areas have resulted in increased ecological complexity and diversity on the site. The site’s terrestrial habitat is primarily comprised of forestland, totaling approximately 94 percent of the area encompassed by the SRS (Workman and McLeod 1990). Batson et al. (1985) lists 1,322 vegetation species found on the site. These species occur over many habitat types, from upland well-drained forests to bottomland hardwood swamps. Detailed descriptions of the SRS land cover types and their associated vegetation can be found in Kilgo and Blake (2005), Workman and McLeod (1990), and Wike et al. (2006).

The proposed 530-ac GNEP site is largely forested, occupied by a mosaic of stands of loblolly pine, longleaf pine, slash pine and white oak. The loblolly stands, encompassing 66 percent of the project site, vary in age from about 19 to 50 years. About 11 percent of the site is longleaf pine planted in 1992. The stands of slash pine, also occupying 11 percent of the site, are generally older, dating back to the early 1950s. Scattered small pockets of 40- and 60-year old white oak stands total about four percent of the project area (DOE 1999a; USFS-SR, pers. comm.). Understory species found on the GNEP site include vacciniums (blueberries), sparkleberry, hickories, laurel oak, water oak, southern red oak, sweetgum, black cherry, persimmon, sassafras, and winged sumac. Ground cover includes Japanese honeysuckle, yellow jessamine, green brier, muscadine grape, spotted wintergreen, various grasses, legumes, and composites (Imm 1997). Forest management practices have included controlled burning, harvesting of mature trees, and reforesting (Kilgo and Blake 2005).

Forested areas on the SRS support a diversity of wildlife habitats that are restricted from public use. The overall site now supports 44 species of amphibians, 59 species of reptiles, 255 species of birds, and 55 species of mammals. These populations include several commercially and recreationally important species. Wildlife management includes control of white-tailed deer (*Odocoileous virginianus*) and wild pig (*Sus scrofa*) populations through supervised hunts. Several wildlife species have been observed in and around the general area of the proposed GNEP site. The wildlife species composition is comparable to similar habitat types elsewhere on SRS. Comprehensive listings of wildlife species can be found in Kilgo and Blake (2005) and Wike et al. (2006).

Approximately 25 percent of the SRS's surface area is covered by water, including wetlands, bottomland hardwoods, cypress-tupelo swamp forests, two large cooling water reservoirs (i.e., PAR Pond and L Lake), creeks and streams, and over 350 isolated upland Carolina bays and wetland depressions (DOE 1999b; Kilgo and Blake 2005; Lide et al. 1995; Wike et al. 2006). The aquatic resources of the SRS have been the subject of intensive study for more than 40 years. Detailed information on SRS aquatic biota and aquatic ecosystems appears in several monographs (Marcy et al. 2005; Patrick et al. 1967), the 8-volume Comprehensive Cooling Water Study (DuPont 1987), and a number of environmental impact statements concerned with SRS water resources (DOE 1984; 1987; 1990; 1997).

The proposed GNEP site is primarily located on an upland area which drains to several tributaries of Upper Three Runs. These include Mill Creek to the east, Tinker Creek to the north, and McQueen Branch to the west (USGS 1987). The nearest 100-year floodplain and jurisdictional waters/wetlands are those associated with the Upper Three Runs drainage corridor (NUS Corporation 1984). In addition, a small wetland is situated approximately 200 meters (656 feet) to the west and down slope of the proposed GNEP site boundary. The locations of surface streams relative to the proposed GNEP site and their associated 100-year floodplains, wetlands, and ecological set-asides are illustrated in **Figure A-3**.

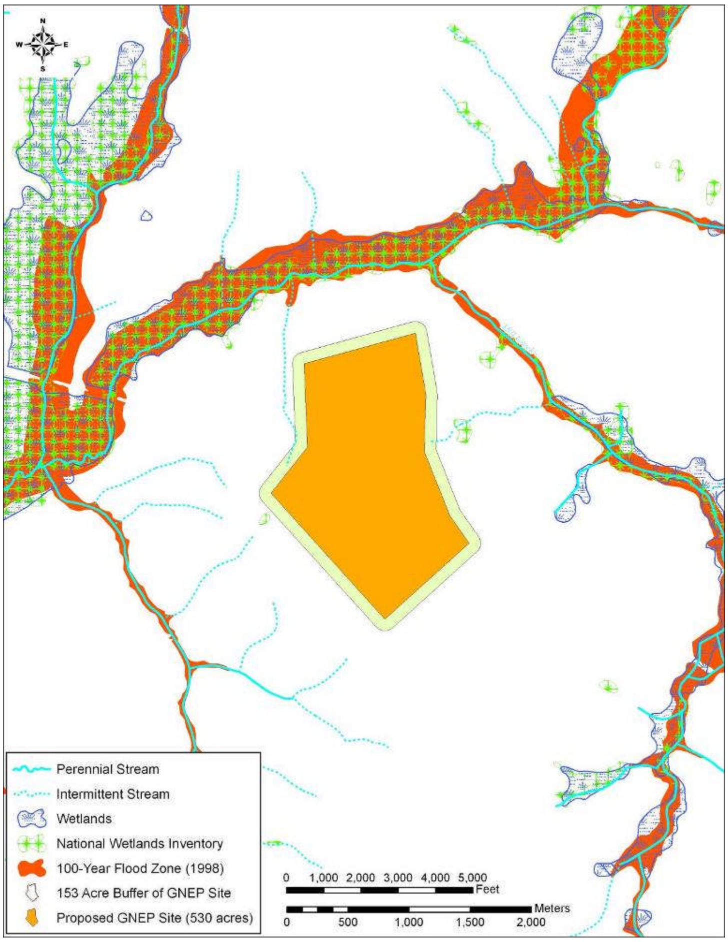


Figure A-3. *The locations of surface streams relative to the Energy Park site and their associated 100-year floodplains, and wetlands, are illustrated.*

The Upper Three Runs watershed, within which the proposed GNEP site is located, is ecologically very diverse. At least 551 species of aquatic insects occur in Upper Three Runs, including at least 52 species and 2 genera new to science. The fish assemblage in Upper Three Runs is similar to that of other blackwater streams in the area. A total of 37 fish species have been found in the Upper Three Runs drainage basin, and fish populations in most portions of the basin are dominated by shiners and sunfishes (Kilgo and Blake 2005; Marcy et al. 2005; Wike et al. 2006).

Threatened and Endangered Species

Seven species on SRS are afforded protection by the Federal Government under the Endangered Species Act of 1973. These are the bald eagle (*Haliaeetus leucocephalus*), wood stork (*Mycteria americana*), red-cockaded woodpecker (*Picoides borealis*), American alligator (*Alligator mississippiensis*), shortnose sturgeon (*Acipenser brevirostrum*), smooth purple coneflower (*Echinacea laevigata*), and pondberry (*Lindera melissifolia*). There are no designated critical habitats for any Federally-listed threatened or endangered species anywhere on the SRS. None of the aforementioned listed species are known to occur on or near the proposed GNEP site (Imm 1997; Kilgo and Blake 2005; Wike et al. 2006).

Cultural Resources

The proposed GNEP site comprises large tracks of land previously evaluated by the Savannah River Archaeological Research Program in 1986 for a new waste storage/disposal facility and again in 1996 for the proposed Accelerator for Production of Tritium project (USDOE 1997). The latter survey resulted in the discovery of seven archaeological sites: one site consisting of a prehistoric lithic scatter and the remaining sites consisting of late 19th- and 20th-century homesites. Based upon these data, the proposed GNEP site could be developed without adversely impacting archaeological or historical resources.

1.1.2.1.1.1 Specification of Location

1.1.2.1.1.2 Site Area Map

The boundary of the proposed GNEP site exclusion area is illustrated in **Figure A-4**.

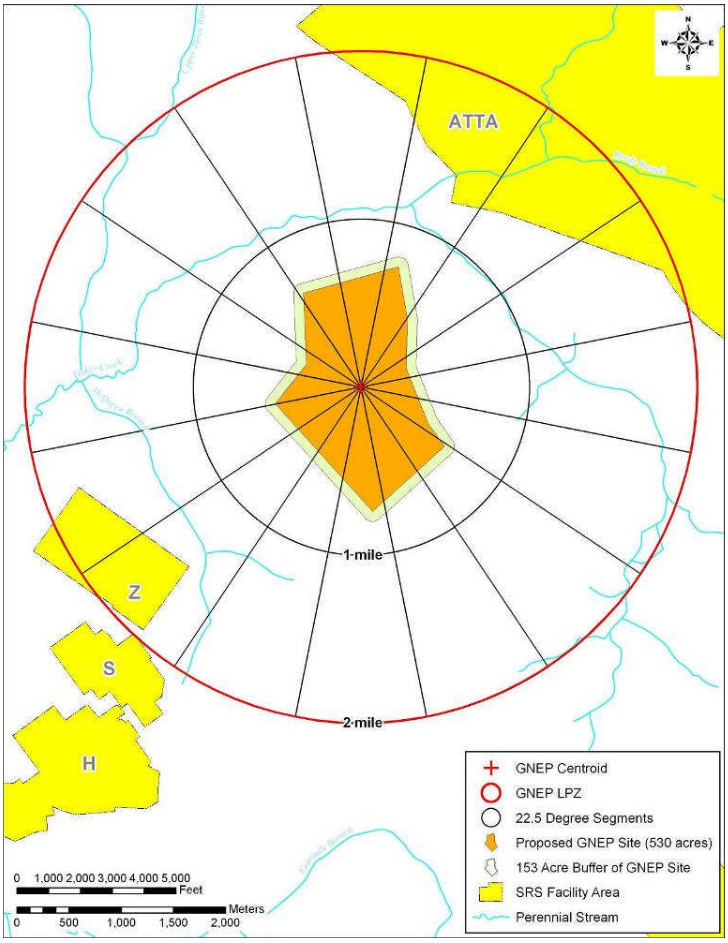


Figure A-4. *Low Population Zone, showing population sectors within two miles of the Energy Park. There is no permanent population within two miles of the SRS Energy Park.*

1.1.2.1.1.3 Boundaries for Establishing Effluent Release Limits

Access control is provided by both the SRS boundary and GNEP exclusion area fenceline. For purposes of this site selection effort, a ‘greenfield’ scenario is assumed (i.e., no connection to available SRS infrastructure) and that any cooling water discharges would be to Par Pond or facility cooling towers. There is no facility-specific data available regarding emissions/discharges.

1.1.2.1.2 Exclusion Area Authority and Control

1.1.2.1.2.1 Authority

Assume exclusion area leased from DOE per DOE Order 130.B; issues regarding private property, mineral rights, etc., not applicable.

1.1.2.1.2.2 Control of Activities Unrelated to Plant Operation – no applicable

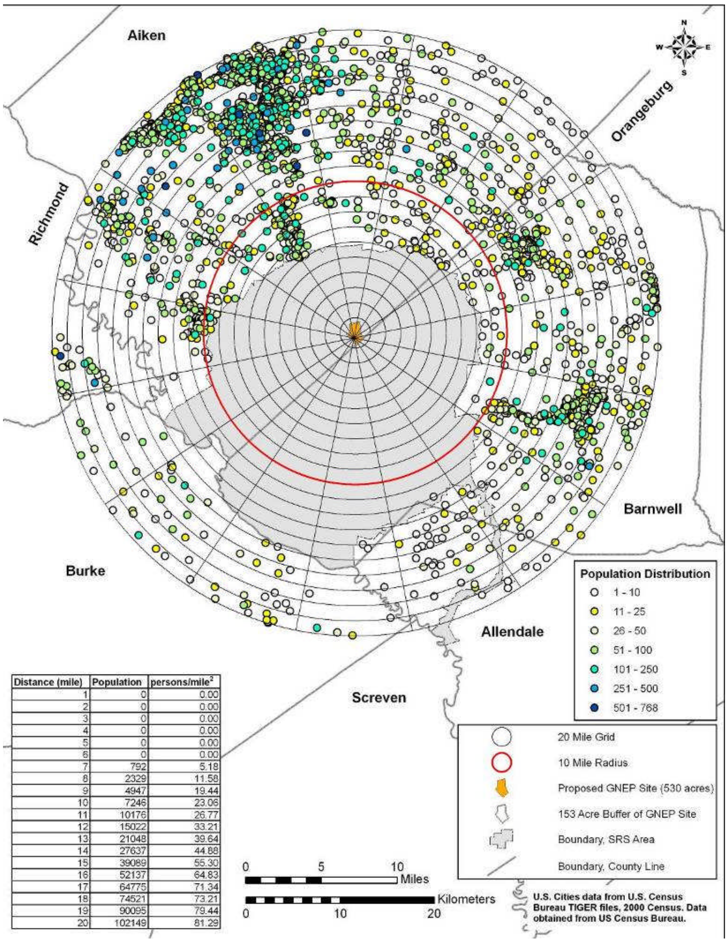
1.1.2.1.2.3 Arrangements for Traffic Control – not applicable

1.1.2.1.2.4 Abandonment or Relocation of Roads – no applicable

1.1.2.1.3 Population Distribution

1.1.2.1.3.1 Population within 10 Miles

The population distribution within 10 miles of the proposed GNEP site is illustrated in **Figure A-5**.



Distance (mile)	Population	persons/mile^2
1	0	0.00
2	0	0.00
3	0	0.00
4	0	0.00
5	0	0.00
6	0	0.00
7	792	5.18
8	2329	11.58
9	4947	19.44
10	7246	23.06
11	10176	26.77
12	15022	33.21
13	21048	39.64
14	27637	44.88
15	39089	55.30
16	52137	64.83
17	64775	71.34
18	74521	73.21
19	90095	79.44
20	102149	81.29

Figure A-5. *Population distribution surrounding An Energy Park to 10 and 20 miles showing actual numbers by location. The red line is 10 miles.*

1.1.2.1.3.2 Population between 10, 20, and 50 Miles

The population distribution between 10 and 20 miles of the proposed GNEP site is illustrated in **Figures A-5** and **A-6**.

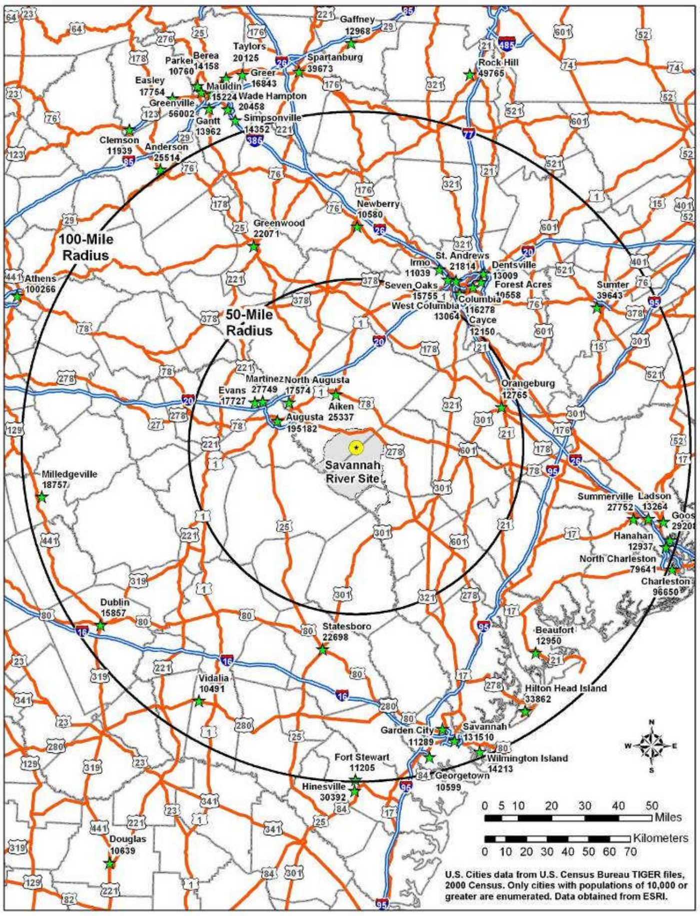


Figure A-6. *Population centers out to 50 miles.*

1.1.2.1.3.3 Transient Population

Transient population within five miles of the proposed GNEP site is defined as industrial workers in SRS facilities, personnel at the SREL Conference Center, and traffic along US Highway #278 and SC Highway #125. The locations of these transient populations are illustrated in **Figure A-7**.

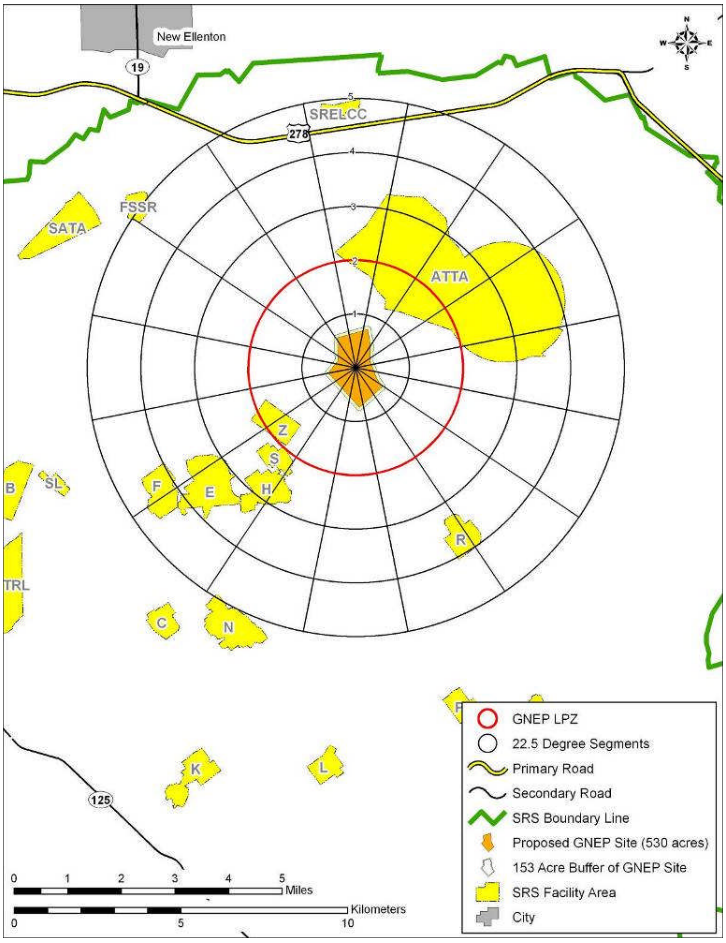


Figure A-7. *Transient population sectors within five miles of An Energy Park. There is no permanent population within five miles of the SRS Energy Park.*

1.1.2.1.3.4 Low Population Zone

The low population zone (LPZ) is defined as the area immediately surrounding the GNEP exclusion area which contains residents, the total number and density of which are such that there is a reasonable probability that appropriate protective measures could be taken on their behalf in the event of a serious accident. The LPZ surrounding the proposed GNEP site constitutes a two-mile buffer that is located totally within SRS and therefore possesses no residents (see **Figure A-4**). SRS facilities located within the LPZ include the Advanced Technical Training Area (ATTA) and Z-Area. The evacuation of SRS workers located within the LPZ would be implemented via use of the site's public address and road systems.

1.1.2.1.3.5 Population Center

The distances from the proposed GNEP site to the nearest boundary of a densely populated center containing more than about 25,000 residents are illustrated in **Figure A-8**.

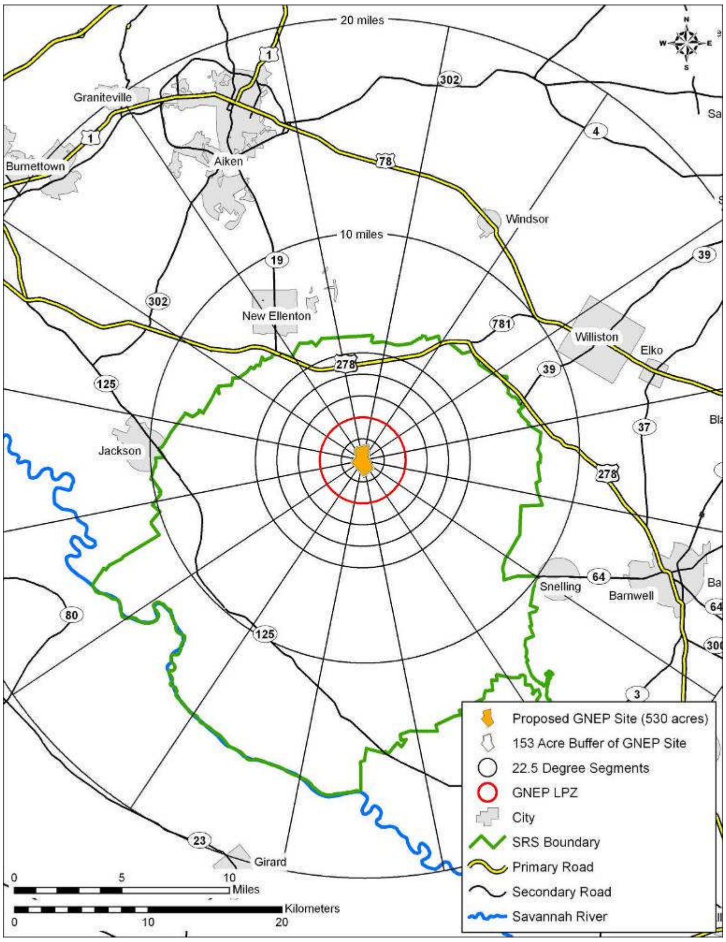


Figure A-8. *Shown are the distances from the a GNEP site to the nearest boundary of a densely populated center containing more than 25,000 residents (Aiken).*

1.1.2.1.3.6 Population Density

Population densities in areas surrounding the SRS are illustrated in **Figure A-5**.

1.1.2.2 Nearby Industrial, Transportation, and Military Facilities

1.1.2.2.1 Locations and Routes

The locations of railroads, airports, and major highways relative to the proposed GNEP site within SRS are illustrated in **Figure A-9**.

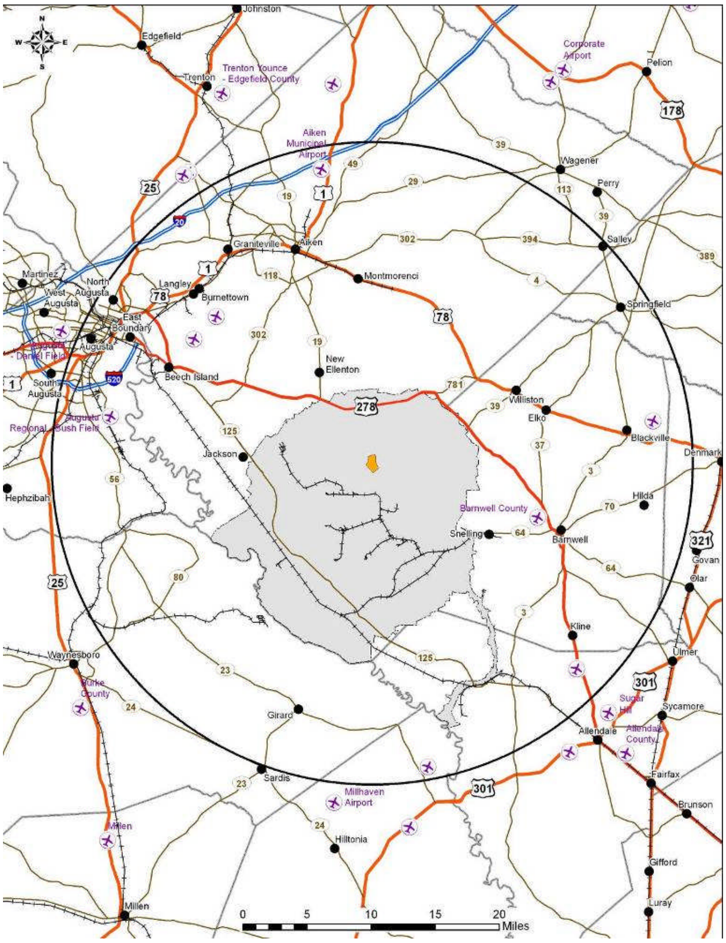


Figure A-9. *Locations of cities, towns, major roadways, railroad lines, and airports within An Energy Park area.*

1.1.2.2.2 Descriptions

1.1.2.2.2.1 Description of Facilities

1.1.2.2.2.2 Description of Products and Materials

SRS activities and facilities within a five mile radius of the proposed GNEP site relate to environmental restoration and closure (sitewide), tactical training for security forces (ATTA), management of radioactive waste materials (Z-, S-, H-, and E-areas) and tritium extraction (H-Area) (see **Figure A-7**).

1.1.2.2.2.3 Description of Pipelines – not applicable.

1.1.2.2.2.4 Description of Highways

Major public access highways closest to the proposed GNEP site include US Highway #278 and SC Highway #125 (see **Figure A-9**). Both of these highways transect SRS, but public access to the site is controlled.

1.1.2.2.2.6 Description of Railroads

The locations of railroads in the vicinity of the proposed GNEP site are illustrated in **Figure A-9**. SRS has its own railroad system.

1.1.2.2.2.7 Description of Airports

There are no significant airport facilities within five miles of the proposed GNEP site . The

closest major airport is Bush Field in Augusta, GA. (see **Figure A-9**).

1.1.2.2.2.8 Projections of Industrial Growth – not applicable

1.1.2.2.3 Evaluation of Potential Accidents

Since there is no final design or safety basis for the NFRC and ARR no evaluation of potential accidents has been performed.

1.1.2.2.3.1 Determination of Design-Basis Events

Since there is no final design or safety basis for the NFRC and ARR no evaluation of design basis events has been performed.

1.1.2.2.3.2 Effects of Design-Basis Events

Since there is no final design or safety basis for the NFRC and ARR no evaluation of design basis events has been performed.

Regional and Local Meteorology

The SRS region has a humid subtropical climate, characterized by relatively short, mild winters and long, warm, and humid summers (Oliver and Fairbridge 1987). Summer weather usually lasts from May through September, when the area is subject to the influence of a semi-permanent Atlantic subtropical anticyclone (the "Bermuda high" pressure system). Winds in the summer are generally light and weather associated with mid-latitude lows and fronts usually remain well to the north of the area. Because the Bermuda high is a persistent feature, there are few breaks in the summer heat. Daily high temperatures during the summer months are greater than 90°F on more than half of all days. Scattered afternoon and evening thunderstorms are common.

The influence of the Bermuda high begins to diminish during the fall, resulting in lower humidity and more moderate temperatures. Average rainfall during the fall is usually the least of the four annual seasons. Fall days are characterized by cool, clear mornings and warm, sunny afternoons. Average temperatures during the fall months range from afternoons highs in the 70s (°F) to morning lows in the 50s (°F). In the winter months, mid-latitude low pressure systems and cold fronts often migrate through the region. As a result, weather conditions frequently alternate between warm, moist, subtropical air from the Gulf of Mexico and South Atlantic and cool dry polar air from Canada. The Appalachian Mountains to the north and northwest of the SRS help moderate the extremely cold temperatures that are associated with outbreaks of Arctic air. Consequently, less than one-third of the winter days have minimum temperatures below freezing, and temperatures below 20°F are infrequent. Measurable snowfall occurs an average once every two to three years. Weather during the spring is often somewhat windy, with mild temperatures and relatively low humidity.

Snow and ice storms in the SRS region occur infrequently. Data recorded by the National Weather Service Office (NWS) in Augusta, GA show that snowfalls of one inch or greater occur once every three years on average. Furthermore, any accumulation of snow rarely lasts for more than three days (NCDC 2005). The greatest single snowfall recorded in the SRS area (Augusta, GA) over the period 1949-2006 was in February 1973 when 13.7 inches fell in a 24-hour period. Total accumulation for that storm was 14.0 inches (NCDC 2005). A complete summary of 24-hour and monthly snowfall from the Augusta NWS office is presented in **Table A-1**. The maximum ground snow load for the SRS area for a 100-year recurrence period is estimated to be about five lb-force/ft^2 (ASCE 2003). Heavy rain coincident with a persistent large snowpack would not be expected to occur in this region.

For a nine-year period of record reported by Tattelman (1973), storms resulting in an accumulation of ice on exposed surfaces occurred in the SRS area an average of about once every 2 years. Average ice accumulations for various recurrence intervals for a region that includes SRS and most of the Gulf Coast states are presented in **Table A-2**. The 100-year recurrence ice storm is estimated to produce an accumulation of approximately 0.67 inches (Tattelman et al. 1973). Jones et al. (2002) estimated that the occurrence of a one-half inch ice accumulation coincident with a 3-second wind gust of 30 mph would have an average return period of 50 years.

An average of about 52 thunderstorm days per year was observed in the SRS area during the period 1947-2005 (NCDC 2006). Average thunderstorm days per month observed at the Columbia, SC NWS office are listed in **Table A-3**. Fifty percent of the annual average total occurred in June, July, and August. Thunderstorm occurrence was least frequent during the months of October through January, with an average of about one day per month observed (NCDC 2006). The occurrence of hail with thunderstorms is infrequent. Based on observations by Pautz (1969), hail occurs once every two years on average at SRS. Using an empirical relationship described by Marshall (1973), the number of cloud-to-ground lightning strikes per square kilometer at SRS has been estimated to be ten per year. Measurements of cloud-to-ground lightning strikes recorded from the National

Table A-1. Snow and Sleet Accumulation (in Inches) for Augusta, GA 1949-2003

Month	Average	Maximum / mo.	Maximum / 24-hr
January	0.2	2.6 (1992)	2.6 (1992)
February	0.7	14.0 (1973)	13.7 (1973)
March	<0.1	1.1 (1980)	1.1 (1980)
April	0.0	0.0	0.0
May	0.0	0.0	0.0
June	0.0	0.0	0.0
July	0.0	0.0	0.0
August	0.0	0.0	0.0
September	0.0	0.0	0.0
October	0.0	0.0	0.0
November	0.0	Trace (1968)	Trace (1968)
December	<0.1	1.0 (1993)	1.0 (1993)
Annual	1.1	14.0	13.7 (1973)

Table A-2 - Estimated Ice Accumulation for Various Recurrence Intervals for the Gulf Coast States

Recurrence Interval (yr)	Accumulation (in.)
2	0
5	0.24
10	0.39
25	0.51
50	0.59
100	0.66

Table A- 3 - Average Number of Thunderstorm Days, Columbia SC, 1947-2005

Month	Thunderstorm Days
January	0.9
February	1.5
March	2.5
April	3.6
May	6.1
June	9.4
July	12.4
August	9.4
September	3.6
October	1.4
November	0.9
December	0.4
Annual	52.1

Lightning Detection Network over the ten year period 1989-1998 show an annual average of four strikes per square kilometer in the SRS area (Global Atmospherics Inc 1998).

Weber, et al (1998) identified a total of 165 tornadoes occurring within a 2-degree square of latitude and longitude centered on SRS over the 30-year p eriod from 1967-1996. Tornado occurrences by month and F-scale intensity category for this data set are summarized in **Table A-4**. The F-scale intensity categories are defined in **Table A-5**. About half of the total number of observed tornadoes occurred during the months of March, April, May, and November. However, tornadoes have been observed in the SRS region every month of the year. Based on these data and a site-specific statistical model of tornado risk probability, the average frequency of a tornado striking any point at SRS was estimated to be 2 x 10^{-4} per year, or approximately once every 5000 years.

Predicted maximum tornado wind speeds (3-second gusts) at a given point for return periods up to 10^{7} years are summarized in Table 6. The design basis tornado specified by the Nuclear Regulatory Commission (NRC) in Regulatory Guide (RG) 1.76 for nuclear power plants has a return period of 10^{7} years (USNRC 2007). For the region of the U.S that includes the SRS, the design basis tornado is estimated to have a wind speed of 230 mph (rotational speed of 184 mph and a translational speed of 46 mph) and a maximum pressure drop of 83 mb over a period of 2.2 seconds. Tornado criteria presented in RG 1.76 are based on the Enhanced-Fujita (EF) scale.

Nine tornadoes have occurred at or in close proximity to SRS since operations began in the 1950s. A tornado that occurred on October 1, 1989 knocked down several thousand trees over a 16-mile path across the southern and eastern portions of the site. Wind speeds produced by this F-2 tornado were estimated to be as high as 150 mph (240 km/h) (Parker and Kurzeja 1989). Four F-2 tornadoes struck forested areas of SRS on three separate days during March 1991. Considerable damage to trees was observed in the affected area. The other four confirmed tornadoes were classified as F-l and produced relatively minor damage. None of the nine tornadoes caused damage to buildings (Parker 1991).

Table A-4 - Number of Tornadoes Reported Between 1951 and 1996 by Month and F-Scale in a Two-Degree Square Centered at SRS

Month	F0	F1	F2	F3	F4	F5	Total	Percent
January	3	8	2	1	0	0	14	7.0
February	4	12	1	0	0	0	17	8.5
March	1	10	9	0	1	0	21	10.5
April	4	17	4	1	0	0	26	13.0
May	3	18	6	0	0	0	27	13.5
June	4	10	0	0	0	0	14	7.0
July	2	8	3	0	0	0	13	6.5
August	4	7	5	2	0	0	18	9.0
September	0	5	3	0	0	0	8	4.0
October	1	2	4	0	0	0	7	3.5
November	10	8	7	2	0	0	27	13.5
December	1	2	2	2	1	0	8	4.0
Total	37	107	46	8	2	0	200	100.0

Table A-5 - Fujita (F) Scale and Enhanced Fujita (EF) Scale for Damaging Tornado Winds

F Scale	3-Second Gust Speed (mph)	EF-Scale	3-Second Gust Speed (mph)	Expected Damage
F0	45-78	EF0	65-85	Light
F1	79-117	EF1	86-109	Moderate
F2	118-161	EF2	110-137	Considerable
F3	162-209	EF3	138-167	Severe
F4	210-261	EF4	168-199	Devastating
F5	262-317	EF5	200-234	Incredible

Table A-6 - Estimated Maximum Three-Second Wind speeds for Tornadoes and 'Straight-Line' Winds

Recurrence Interval (years)	Probability (events/year)	Estimated Maximum 3-Sec Wind Speed (mph)	
		Tornadoes	'Straight-line' Wind
10	1 x 10^{-1}	---	69
50	2 x 10^{-2}	---	83
100	1 x 10^{-2}	---	88
200	5 x 10^{-3}	---	94
500	2 x 10^{-3}	---	102
1,000	1 x 10^{-3}	---	107
5,000	2 x 10^{-4}	45	120
10,000	1 x 10^{-4}	78	126
100,000	1 x 10^{-5}	170	145
500,000	2 x 10^{-6}	215	---
1,000,000	1 x 10^{-6}	230	---
10,000,000	1 x 10^{-7}	285	---

Excluding tornadoes, extreme winds in the SRS region are associated with tropical weather systems, thunderstorms, or strong winter storms. The maximum one-minute wind speed observed at the Augusta NWS office since 1950 was 83 mph (133 km/h) in May 1950 (Hunter 1989). Predicted maximum "straight-line" (nontornadic) 3-second wind speeds for any point at SRS for return periods from 10 to 100,000 years are summarized in **Table A-6**. The predicted values were generated from a Fisher-Tippet Type I extreme value distribution function using historical wind speed (gust) data from the SRS meteorological database and from nearby NWS stations (Columbia, SC and Augusta, Macon, and Athens, GA). The 100-year 3-second wind speed was estimated to be 88 mph (141 km/h) (Weber et al. 1998).

Table A-7 - Total Occurrence of Hurricanes in South Carolina by Month, 1700-2006

Month	Number	Percent of Total
June	1	2.7
July	2	5.4
August	12	32.4
September	18	48.6
October	4	10.8

Because the SRS is approximately 100 miles (160 km) inland, winds associated with tropical weather systems usually diminish below hurricane force (sustained speeds of 75 mph [120 km/h] or greater). However, winds associated with Hurricane Gracie, which passed to the north of SRS on September 29, 1959, were measured as high as 75 mph (120 km/h) on an anemometer located in F-Area (Hunter 1989). No other hurricane-force wind has been measured on the site. On September 22, 1989, the center of Hurricane Hugo passed about 100 miles (160 km) northeast of SRS. The maximum 15-minute average wind speed observed onsite during this hurricane was 38 mph (61 km/h). The highest observed instantaneous wind speed was 62 mph (100 km/h) (14). These data were collected from the onsite tower network (measurements taken at 200 feet [60 meters] above ground). Extreme rainfall and tornadoes, which frequently accompany tropical weather systems, usually have the most significant hurricane-related impact on SRS operations. Approximately 80% of hurricanes in South Carolina have occurred in August and September (see **Table A-7**).

Table A-8 - Observed Extreme Rainfall for SRS Region

		Augusta Bush Field		Columbia Airport	
Period (Hours)	Period (Days)	Inches/ Period	Begin Date	Inches/ Period	Begin Date
1		3.14	7/24/86	3.80	8/18/65
3		4.25	9/20/75	5.03	
6		4.50	9/20/75	5.29	6/15/73
12		7.62	10/11/90	7.03	8/16/49
24		8.57	10/11/90	7.66	
	3	12.24	10/10/90	8.41	8/14/90
	7	12.24	10/10/90	10.22	6/15/73
	10	12.24	10/10/90	10.29	6/13/73
	14	14.56	10/10/90	14.71	8/14/49
	30	15.47	9/30/90	19.30	7/29/49

Historical rainfall maxima observed at the Augusta, GA and Columbia, SC NWS offices for durations from one hour to 30 days are summarized in **Table A-8** (Addis and Kurzeja 1990). Estimated rainfall extremes at SRS for durations from 15 minutes to two days and return periods from 10 to 100,000 years are summarized in **Table A-9**. These estimates were generated from a Fisher-Tippett Type I or Type II extreme value distribution function using historical precipitation data from the SRS meteorological database and nearby NWS stations (Weber et al. 1998). Several significant rainfall events occurred at SRS in the summer and fall of 1990. **Table A-9**

Table A-9 - Extreme Precipitation Recurrence Estimates by Accumulation Period

Recurrence Interval (years)	15 Min	1 Hr	3 Hr	6 Hr	24 Hr	48 Hr
10	1.5	2.7	3.3	3.6	5.0	6.5 (7.39)b
25	1.8	3.2	4.0	4.4	6.1	7.9
50	2.0	3.5	4.6	5.0	6.9 (7.39)b	8.6
100	2.1	3.9	5.1 (5.2)a	5.7 (5.8)b	7.8	9.4 (10.2)c
1000	2.7	5.0	7.4	8.3	11.5	---
10,000	3.3	6.2	10.3	11.8	16.3	---
100,000	3.9	7.4	14.1	16.7	22.7	---

[a] *Observed in the SRS A-Area July 25, 1990*
[b] *Observed at the Central Climatology station August 22, 1990*
[c] *Observed in the SRS A-Area October 11-12, 1990*

includes the observed rainfall totals from these storms that exceeded the predicted extreme rainfall values (Addis and Kurzeja 1990).

Annual average and extreme precipitation for SRS over the 30-year period 1977-2006 is summarized in **Table A-10**. Precipitation is fairly evenly distributed throughout the year. Average precipitation for the fall months (September, October, and November) is less than that for the other seasons, accounting for about 20% of the average a nnual total. Monthly precipitation extremes for SRS range from a maximum of 19.62 inches, recorded in October 1990, to a trace observed in October 1963 (Kaela and Hunter 2007). Since 1995, precipitation totals greater than 0.01 inch have occurred on an average of about 103 days per year, and precipitation greater than one-half inch has occurred an average of 31 days per year. Monthly and annual total rain hours are summarized in **Table A-11**. **Table A-12** summarizes rainfall during 1995-2006 for accumulation periods of 1, 2, 3, 6, 12 and 24 hours. The greatest 1-hour and 24-hour rainfall during this period was 2.24 in and 4.88 in, respectively. Short-term rainfall maxima are associated with summer thunderstorms; longer-term maxima are generally the result of tropical weather systems.

Table A-10 - Monthly and Annual Precipitation for SRS (Water Equivalent)

	Average Daily Precipitation (in)[1]	Extreme Precipitation (in)[2]	
Month	Average	Minimum (Yr)	Maximum (Yr)
January	4.28	0.89 (1981)	10.02 (1978)
February	4.32	0.73 (2000)	8.90 (1998)
March	4.37	0.81 (2004)	10.96 (1980)
April	3.16	0.57 (1972)	8.43 (2003)
May	3.23	1.26 (1999)	10.90 (1976)
June	4.97	0.89 (1990)	10.99 (2003)
July	5.51	0.90 (1980)	11.49 (1982)
August	4.88	1.04 (1963)	12.34 (1964)
September	3.97	0.19 (2005)	10.26 (2004)
October	3.14	0.00 (1963)	19.62 (1990)
November	2.94	0.21 (1958)	7.78 (1992)
December	3.39	0.46 (1955)	9.55 (1997)
Annual	48.52	28.82 (1954)	73.47 (1964)

[1] *Period of record: 1977-2006.*
[2] *Period of record: 1961-2006.*

Table A-11 - Monthly and Annual Number of Hours of Precipitation for SRS 1995-2006

	Number of Hours		
Month	Average	Minimum (Yr)	Maximum (Yr)
January	57	35 (2005)	91 (1998)
February	55	14 (2000)	93 (2004)
March	50	13 (2006)	98 (2003)
April	38	16 (1995)	75 (2003)
May	27	7 (2000)	59 (2003)
June	46	25 (1996)	82 (2005)
July	36	14 (2000)	61 (2003)
August	32	14 (1997)	54 (1995)
September	46	5 (2005)	72 (2004)
October	34	2 (2000)	67 (2002)
November	38	22 (1996)	78 (1997)
December	45	14 (2001)	94 (1997)
Annual	505		

[1]*For period of record: 1995-2006*

Table A-12 - Monthly and Annual Maximum Rainfall Rate Distribution for SRS 1995-2006

	Rainfall Rate by Period					
Month	1	2	3	6	12	24
January	1.05	1.36	1.49	1.94	2.11	2.62
February	0.97	1.56	1.78	2.10	2.44	2.54
March	1.02	1.34	1.57	1.83	2.53	3.27
April	1.36	2.15	2.28	3.19	3.50	3.50
May	1.29	1.48	1.48	2.15	2.20	2.66
June	2.01	2.80	3.33	3.69	3.99	4.10
July	2.24	2.61	2.66	2.91	2.91	3.19
August	1.45	2.14	2.51	2.52	3.20	4.17
September	2.15	3.39	3.52	3.86	4.42	4.88
October	0.87	1.09	1.23	1.43	1.68	2.01
November	0.79	1.05	1.26	1.83	2.42	2.59
December	1.14	1.68	1.81	3.10	3.17	3.18
Annual Maximum	2.24	3.39	3.52	3.86	4.42	4.88

Monthly and annual average temperatures for SRS for the 30-year period 1977-2006 are summarized in **Table A-13**. July is the warmest month with an average daily high temperature of 92.0°F and an average minimum of 71.6°F. January is the coldest month with an average maximum temperature of 56.2°F and an average minimum temperature of 35.9°F. The annual average temperature is 64.5°F. Observed temperature extremes for SRS over the period 1961-2006 ranged from 107°F (occurring in 1986) to -3°F (occurring in 1985). Daytime high temperatures during the winter months are rarely below 32°F; nighttime lows below 32°F occur on average about 10 days per month in December, January, and February. Conversely, high temperatures in the summer months (June, July and August) are above 90°F on slightly more than half of all days (Kabela and Hunter 2007). Statistics on observed recurrence frequencies for high dry-bulb and wet-bulb temperatures and low dry-bulb temperature are summarized in **Table A-14**.

Table A-13 - Monthly and Annual Average and Extreme Air Temperature for SRS

	Average Temperature (°F)[1]			Extreme Temperature (°F)[2]	
Month	Minimum	Maximum	Average	Minimum (Yr)	Maximum (Yr)
January	35.9	56.2	45.7	-3 (1985)	86 (1975)
February	39.2	60.6	49.6	12 (1996)	86 (1989)
March	45.1	68.0	56.4	11 (1980)	90 (1995)
April	52.2	76.5	64.2	20 (1983)	99 (1986)
May	60.5	83.6	71.9	38 (1989)	102 (1963)
June	68.1	89.1	78.3	48 (1984)	105 (1985)
July	71.6	92.0	81.6	56 (1963)	107 (1986)
August	70.1	90.4	80.3	56 (2004)	107 (1983)
September	65.9	85.1	75.3	41 (1967)	104 (1990)
October	54.8	76.2	65.3	28 (1976)	96 (1986)
November	46.2	67.9	56.7	18 (1970)	89 (1974)
December	38.4	58.6	48.3	5 (1962)	82 (1984)
Annual	54.0	75.4	64.5	-3 (1985)	107 (1986)

[1] *Period of record: 1977-2006.*
[2] *Period of record: 1964-2006.*

Table A-14 - Extreme Temperature Statistics for SRS

Percent Exceedance	Temperature (°F)	Wet-Bulb Temperature (°F)
0.4	99.1	81.2
2	96.3	
99	21.0	
99.6	18.5	

Monthly and annual average dew point temperature for the 12-year period 1995-2006 is summarized in **Table A-15**. Monthly average values range from 67.7°F in July to 36.9°F in January. The lowest dew point recorded in the 12-year period of record was 5°F (January); the highest dew point recorded in the period was 83.1°F (occurring twice in August and September). Monthly and annual average relative humidity for the 12-year period between 1995-2006 is summarized in **Table A-16**. Average relative humidity is typically highest in July, ranging from an average maximum of 92% in the morning to 50% in the afternoon, and lowest in April with average daily values ranging from a maximum 85% in the morning to and minimum of 36% in the afternoon. The occurrence of relative humidity below 15 % is rare. The lowest value that

Table A-15 - Monthly and Annual Average and Extreme Dew Point Temperature for SRS 1995-2006.

	Average Dew Point (°F)	Extreme Dew Point (°F)	
Month	Average	Minimum (Yr)	Maximum (Yr)
January	36.9	5.0 (2003)	69.2 (1999)
February	38.0	5.1 (1995)	65.0 (2004)
March	40.0	7.9 (1998)	69.4 (2000)
April	44.2	13.9 (1997)	72.7 (1999)
May	54.1	25.4 (2006)	78.2 (2000)
June	62.1	38.4 (1997)	81.5 (2003)
July	67.7	49.1 (2006)	83.0 (1997)
August	64.1	24.8 (2001)	83.1 (1997)
September	60.1	37.3 (2006)	83.1 (1998)
October	51.6	18.5 (2001)	77.6 (2001)
November	43.4	12.3 (1999)	70.6 (1996)
December	37.4	5.1 (2004)	68.7 (2001)
Annual	50.0	5.0 (2003)	83.1 (1997,1998)

occurred in the 12-year record was 13% in April 2006. **Table A-17** summarizes monthly and annual average and extreme absolute humidity for the 12-year period. The annual average absolute humidity was 12.9 g/m^3. Monthly averages range from 20.7 g/m^3 in July to 6.9 g/m^3 in January. Extremes for the 12-year record range from a minimum of 1.8 g/m^3 to a maximum of 34.9 g/m^3.

Heavy fog, defined as a recorded visibility of less than 1/4 mile, occurred at the Augusta NWS office on an average of just over 30 days per year during the period 1949-2006. Occurrences averaged about three days per month during the fall and winter months and slightly more than one day per month during the spring and summer months. These data are summarized in **Table A-18**. Most of the heavy fog observed at Augusta is due to the proximity of the Savannah River. Fog is observed less frequently at the SRS because the site is at a higher elevation than Augusta and is further from the river. Most of the instances of fog at SRS are due to strong radiational cooling at night. These fogs generally last no more than a few hours and can be expected to dissipate by mid-morning.

Table A-16 - Monthly and Annual Average Extreme Relative Humidity for SRS 1995-2006

	Average Relative Humidity (%)			Extreme Relative Humidity (%)
Month	Min.	Max.	Ave.	Min. (Yr)
January	45.2	87.8	66.5	19.4 (2006)
February	43.4	87.7	65.6	17.6 (1999)
March	38.6	85.0	61.8	15.6 (2006)
April	36.2	85.0	60.6	13.4 (2006)
May	40.0	88.7	64.4	18.4 (2006)
June	47.5	91.2	69.4	18.2 (1999)
July	49.6	91.6	70.6	27.2 (2006)
August	48.7	90.1	69.4	24.5 (1999)
September	49.0	90.7	69.9	22.7 (1999)
October	47.6	90.4	69.0	19.4 (2005)
November	45.2	88.9	67.1	16.2 (2003)
December	45.4	90.2	67.8	18.0 (1999)
Annual	44.7	88.9	66.8	13.4 (2006)

Table A-17 - Monthly and Annual Average and Extreme Absolute Humidity for SRS 1995-2006

	Average Absolute Humidity (g/m^3)			Extreme Absolute Humidity (g/m^3)	
Month	Min.	Max.	Ave.	Min. (Yr)	Max. (Yr)
January	2.7	11.1	6.9	1.8 (2003)	13.7 (1999)
February	2.8	12.1	7.5	2.4 (2006)	14.1 (2001)
March	3.0	14.3	8.7	2.1 (1999)	17.0 (2000)
April	3.7	19.0	11.4	2.9 (1996)	22.2 (2006)
May	5.4	25.2	15.3	4.4 (2001)	30.1 (2000)
June	8.0	28.9	18.5	6.6 (2006)	34.9 (1998)
July	9.4	31.9	20.7	7.3 (2006)	34.6 (2002)
August	9.1	30.7	19.9	7.3 (1997)	34.4 (1999)
September	7.7	25.7	16.7	6.4 (1999)	28.1 (2005)
October	5.3	20.0	12.7	3.4 (2001)	22.2 (1998)
November	3.6	14.9	9.3	3.0 (1996)	17.4 (1998)
December	2.7	11.4	7.1	2.1 (2003)	14.0 (1998)
Annual	5.3	20.4	12.9	1.8 (2003)	34.9 (1998)

[1] *Period of record: 1995-2006.*

Table A-18 - Monthly and Annual Stability Class Frequencies for SRS 1997-2001

Month	Percent Occurence[1]						
	A	B	C	D	E	F	G
January	17.5	15.3	26.8	22.3	15.7	2.3	0.1
February	22.6	14.6	22.5	20.9	16.2	3.0	0.2
March	24.2	15.9	23.4	20.6	13.3	2.5	0.1
April	24.3	15.4	22.8	21.6	13.7	2.2	0.1
May	29.9	15.6	15.9	21.4	15.1	1.9	0.1
June	32.7	15.2	18.6	22.4	10.2	0.8	0.0
July	37.2	14.1	15.3	20.2	12.3	0.9	0.0
August	34.8	13.0	14.4	21.6	14.8	1.4	0.1
September	27.9	13.6	19.9	20.3	15.8	2.4	0.1
October	25.0	11.7	16.0	21.9	19.4	5.3	0.7
November	22.1	11.1	19.6	22.3	20.1	4.7	0.2
December	19.8	16.8	23.8	21.3	15.0	3.1	0.2
Annual	26.5	14.3	19.9	21.4	15.1	2.5	0.2

Data used to describe local climatological conditions at SRS were obtained from a network of meteorological monitoring stations located across the site and the NWS office in Augusta, GA (approximately 12 miles west-northwest of the SRS). Onsite tower locations are shown on **Figure A-10**. A complete description of the SRS meteorological monitoring program is given in Appendix 2, page 69.

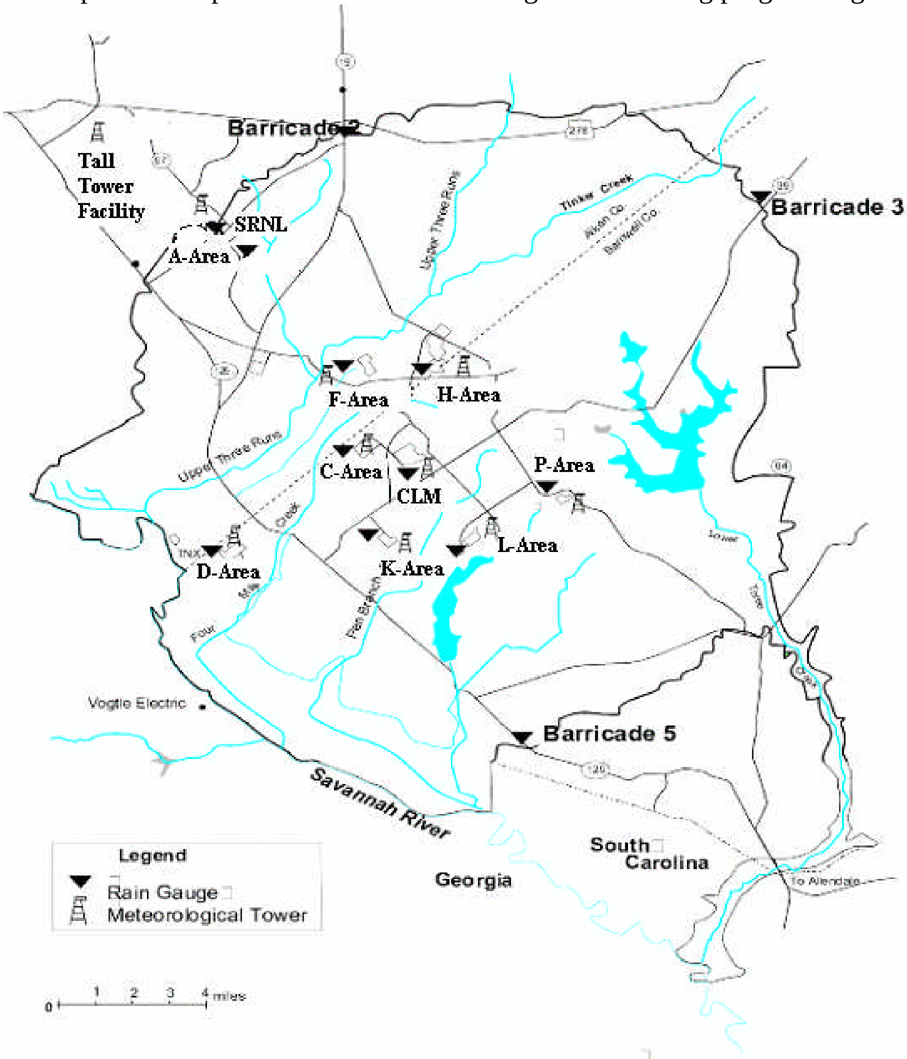


Figure A-10. SRS Meteorological Monitoring Network

Meteorological Factors Affecting Atmospheric Diffusion and Transport

Summaries of the frequency of occurrence of six wind speed categories by sixteen cardinal wind direction sectors are illustrated by the wind rose plots in Fig. 11 and 12. These summaries are based on quality assured, hourly averaged values of wind speed and wind direction data collected at the 200-ft (61 m) level of the H-area meteorological tower. **Figure A-11** shows that for an annual period winds at SRS are most frequently from the south through west sectors and from the northeast sectors.

The strongest wind (speeds greater than 8 m/s [18 mph]) is generally from the southwest through northwest sectors. Monthly wind rose plots in **Figure A-12** indicate some seasonal variability. December through April exhibit relatively high frequencies of wind from the southwest through northwest sectors as a result of the strong winter storms that migrate from west to east across the eastern U.S. Wind directions are predominantly from the south through southwest sectors in the late spring and summer due the persistent presence of the ‘Bermuda’ subtropical high off the southeast U.S. coast. Northeast winds are a frequent occurrence in the late summer and fall due to the frequent presence of high pressure along the U.S. east coast. The average wind speed for the five-year period between 1995-2006 was 3.1 m/s (6.9 mph). Hourly wind speeds are less than 4 m/s about 80 percent of the time and 2 m/s approximately 18 percent of the time.

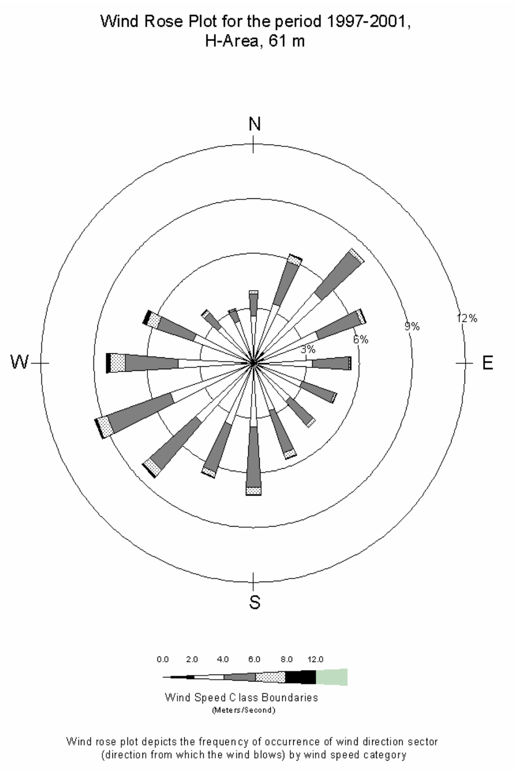


***Figure A-11** – Annual Period Winds at SRS.*

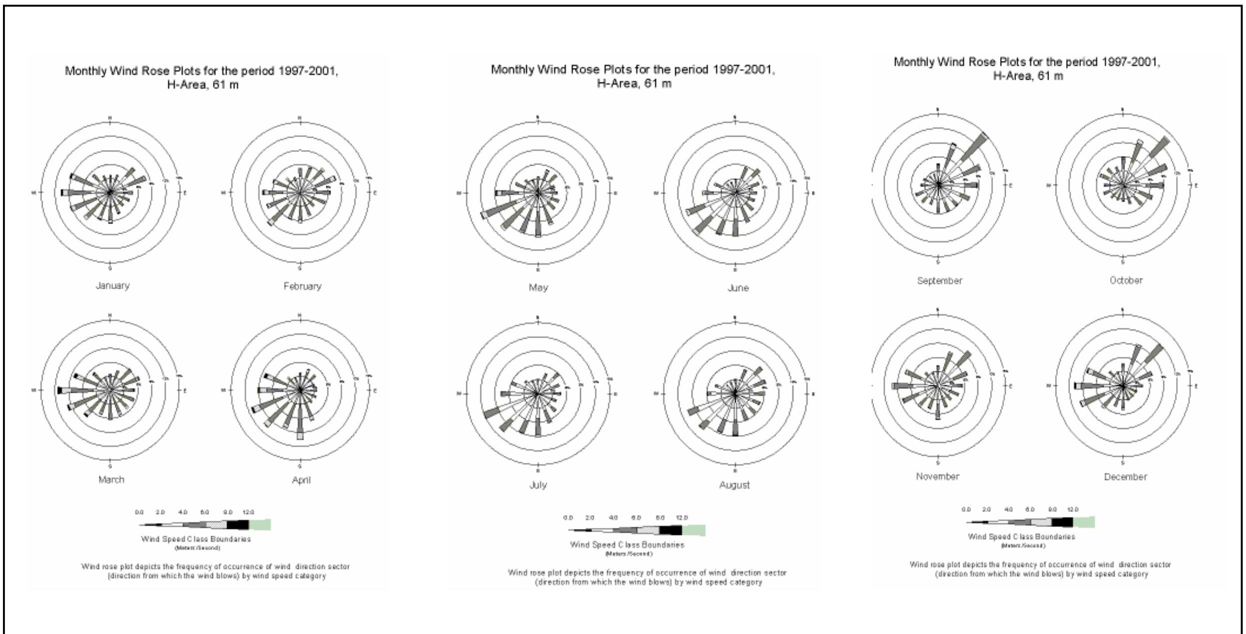


***Figure A-12** –Variability*

A summary of the percent occurrence of Pasquill stability classes A-G from hourly values of sigma azimuth contained in the quality assured, five-year data set for the H-Area tower is given in **Table A-19**. Data indicate that stable conditions, characterized by relatively little turbulence and weak dispersion
(stability classes E, F, and G), occurred less than 20 percent of the time in the five year period. Relatively turbulent, unstable conditions which produce more vigorous diffusion of an effluent (stability class A, B, and C) occurred about 60% of the time. Unstable conditions are more prevalent during the summer months due to a greater number of daylight hours with strong solar insolation. Stable conditions occur slightly more often in the winter months due to longer nights and weaker solar insolation during the days. Wind rose plots by stability class are shown in **Figure A-13**.

Table A-19 - Monthly and Annual Average Fog Days[1]

Month	Average
January	3.1
February	2.2
March	1.8
April	2.0
May	2.1
June	1.4
July	1.4
August	2.6
September	3.3
October	3.5
November	3.7
December	3.7
Annual	30.6

[1]*Period of record: 1949-2006.*

***Figure A-13** – Wind Rose Plots*

Estimates of annual and seasonal average mixing height for mornings and afternoons at SRS are summarized in **Table A-20** (Hunter 2003). These values were determined from daily values that were calculated using an EPA mixing height algorithm. Input data consisted of radiosonde data from Atlanta, GA (the nearest radiosonde site to SRS) and surface data from the NWS office at Augusta, GA for the five years 1997-2001. Analyses by Hosler (1961) found that inversions occur in the SRS area approximately 40% of all hours and 70% of all night hours.

Table A-20 - Average Morning and Afternoon Mixing Height

Season	Mixing Height	
	Morning	Afternoon
Winter	300	1200
Spring	300	1800
Summer	300	1900
Fall	300	1400
Annual	300	1575

Atmospheric Dispersion Estimates

The AXAIRQ computer code was used for short-term atmospheric dispersion estimates. AXAIRQ is a quality assured, site-specific implementation (Simpkins 1995a; 1995b) of the dispersion model outlined in U.S. NRC Regulatory Guide 1.145 (1982). Pasquill-Gifford and Pasquill-Briggs diffusion coefficients are available for use within AXAIRQ. The Pasquill-Briggs coefficients were selected for use in these calculations since they are the more appropriate of the two sets for mainly forested terrain such as that present at SRS. All calculations were performed with a joint frequency distribution constructed from quality assured meteorological data collected from the SRS H-Area meteorological tower over the 5-year period 1997-2001 (Weber 2002). The joint frequency data are summarized in **Table A-21**. A unit source term (1 curie) from a ground-level source was assumed; additional model inputs are listed in **Table A-22**.

Table A-21 - H-Area Five-Year Joint Frequency Distribution (% of total time)

METEOROLOGICAL JOINT FREQUENCY DISTRIBUTION
WIND STATS H-AREA 60 Min. 62M 97-01 STABILITY FROM SIGMA A
TOTAL NO. OF RECORDS OF 60-MIN MET DATA=43824
(SECTOR 1=S, 2+SSW, …, 16-SSE)

SECTOR NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
WIND SPEED(M/SEC) -----PG STABILITY CLASS A -----																
1(0-2)	0.41	0.44	0.35	0.41	0.40	0.42	0.40	0.31	0.35	0.35	0.38	0.50	0.50	0.46	0.41	0.42
2 (2-4)	0.99	0.99	0.94	1.12	0.99	0.90	0.60	0.54	0.71	0.86	1.09	1.72	1.40	0.99	0.59	0.74
3 (4-6)	0.47	.034	0.25	0.27	0.23	0.16	0.11	0.09	0.18	0.19	0.33	0.55	0.49	0.33	0.15	0.19
4 (6-8)	0.06	0.07	0.01	0.01	0.01	0.00	0.01	0.00	0.02	0.01	0.03	0.05	0.06	0.05	0.01	0.03
5 (8-12)	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
6 (> 12)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WIND SPEED(M/SEC) -----PG STABILITY CLASS B -----																
1(0-2)	0.09	0.08	0.10	0.09	0.06	0.05	0.04	0.04	0.05	0.03	0.06	0.05	0.07	0.08	0.05	0.05
2 (2-4)	0.50	0.52	0.53	0.63	0.44	0.26	0.22	0.21	0.30	0.32	0.50	0.74	0.48	0.42	0.21	0.24
3 (4-6)	0.36	0.40	0.36	0.44	0.25	0.18	0.10	0.13	0.18	0.27	0.44	0.69	0.59	0.29	0.13	0.11
4 (6-8)	0.06	0.12	0.03	0.06	0.01	0.02	0.01	0.02	0.03	0.02	0.15	0.33	0.37	0.24	0.02	0.03
5 (8-12)	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.03	0.03	0.11	0.09	0.02	0.02
6 (> 12)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WIND SPEED(M/SEC) -----PG STABILITY CLASS C -----																
1(0-2)	0.05	0.09	0.08	0.05	0.04	0.03	0.05	0.05	0.04	0.04	0.08	0.05	0.04	0.05	0.03	0.05
2 (2-4)	0.34	0.55	1.01	0.83	0.55	0.41	0.39	0.26	0.49	0.52	0.64	0.73	0.63	0.52	0.29	0.23
3 (4-6)	0.17	0.55	1.12	0.71	0.39	0.32	0.36	0.29	0.50	0.47	0.63	0.84	0.73	0.53	0.18	0.10
4 (6-8)	0.00	0.12	0.12	0.13	0.05	0.06	0.06	0.13	0.16	0.12	0.20	0.28	0.35	0.33	0.13	0.03
5 (8-12)	0.00	0.03	0.01	0.01	0.00	0.01	0.00	0.03	0.03	0.04	0.05	0.04	0.10	0.11	0.02	0.00
6 (> 12)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WIND SPEED(M/SEC) -----PG STABILITY CLASS D -----																
1(0-2)	0.02	0.04	0.06	0.04	0.03	0.03	0.07	0.07	0.04	0.03	0.02	0.05	0.03	0.03	0.06	0.03
2 (2-4)	0.13	0.46	0.91	0.68	0.55	0.49	0.50	0.52	0.82	0.74	0.81	0.79	0.67	0.62	0.47	0.29
3 (4-6)	0.10	0.48	0.78	0.64	0.62	0.49	0.68	1.09	1.39	0.90	0.97	0.87	0.79	0.61	0.26	0.10
4 (6-8)	0.00	0.01	0.00	0.01	0.01	0.01	0.03	0.14	0.15	0.05	0.08	0.03	0.01	0.02	0.02	0.00
5 (8-12)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 (> 12)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WIND SPEED(M/SEC) ----- PG STABILITY CLASS E -----																
1(0-2)	0.00	0.01	0.01	0.00	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.00	0.02	0.01	0.01	0.02
2 (2-4)	0.03	0.30	0.59	0.31	0.28	0.34	0.35	0.51	0.59	0.57	0.55	0.47	0.32	0.34	0.30	0.29
3 (4-6)	0.04	0.64	0.43	0.59	0.51	0.57	0.45	0.69	0.93	0.93	0.96	0.85	0.46	0.34	0.18	0.10
4 (6-8)	0.00	0.02	0.00	0.01	0.01	0.01	0.00	0.00	0.03	0.01	0.02	0.00	0.00	0.00	0.00	0.00
5 (8-12)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 (> 12)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WIND SPEED(M/SEC) ----- PG STABILITY CLASS F -----																
1(0-2)	00.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 (2-4)	0.01	0.07	0.08	0.01	0.03	0.07	0.06	0.09	0.10	0.04	0.08	0.08	0.02	0.04	0.05	0.03
3 (4-6)	0.04	0.24	0.06	0.05	0.06	0.22	0.08	0.13	0.13	0.15	0.13	0.13	0.07	0.06	0.07	0.03
4 (6-8)	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 (8-12)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 (> 12)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WIND SPEED(M/SEC) ----- PG STABILITY CLASS G -----																
1(0-2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 (2-4)	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
3 (4-6)	0.01	0.02	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
4 (6-8)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 (8-12)	00.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 (> 12)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A-22 - Short-Term Atmospheric Dispersion Input Parameters

Parameter	Input
Release Location	76337 E, 76381 N
Release Type	(0) Vent
Release Height	0 meters
Minimum Vertical Cross-Section Of Adjacent Solid Structure	Blank since unknown
Sector Analysis	0 (all sectors)
Met Library	New (1997-2001)
Calendar Year	2007
95th(1) or 50th(2) Percentile Doses?	1
Deposition	Yes
Diffusion Coefficient PB(1) PG(2)	1
Mixing Height	200
Number of User Distances	3 (0.062, 0.52, 2 miles)
Nuclide/Curies	H-3/1

Table A-23. Short-Term Dispersion Estimates ((χ/Q in sec/m^3)

Time Period (hrs)	Site Boundary (Exclusion Area)		LPZ	
	99.5 Percentile	95 Percentile	99.5 Percentile	95 Percentile
2	3.70E-04	3.96E-04	5.48E-05	5.48E-05
8	1.55E-04	1.66E-04	2.24E-05	2.24E-05
16	1.00E-04	1.07E-04	1.43E-05	1.43E-05
72	3.88E-05	4.16E-05	5.40E-06	5.40E-06
624	9.99E-06	1.07E-05	1.34E-06	1.34E-06

AXAIRQ results consist of 2-hour relative air concentrations (χ/Q) that are exceeded 0.5 of the time for each of the sixteen 22.5 degrees wind sectors and five percent of the time for a cumulative distribution of χ/Q independent of wind direction. Calculations were performed for an exclusion area boundary of 0.52 miles and an outer distance of the low population zone of two miles. The code also determines 8, 16, 72 (three day) and 624 (30 day) hour average χ/Qs using the following algorithm for logarithmic interpolation:

$$\frac{\chi}{Q}_{\text{time period}} = \frac{\chi}{Q}_{anual} \exp\left[\ln\left(\left(\frac{\chi/Q_{2hr}}{\chi/Q_{annual}}\right)\right)\left(\frac{\ln(8760) - \ln(\text{time period})}{\ln(8760) - \ln 2}\right)\right]$$

The interpolations are based on the calculated 2-hour χ/Q s (sector maximum 0.5 percentile value and the overall five percentile value) and maximum annual average χ/Q for each of the 16 sectors. Results are summarized in **Table A-23** and **Figure A-5** (0.5 percentile values) and 6 (5 percentile value).

The POPDOSE-SR code was used to estimate realistic annual average relative concentration (χ/Q values) and deposition (D/Q values) to a distance of 50 miles (80 km) for a postulated unit source term. The basis for this model is the NRC's XOQDOQ which was adapted for use at SRS to include site-specific input parameters, source configuration, and topography (Simpkins 2000; USNRC 1976). No credit is taken for plume rise induced by momentum or thermal effects.

All calculations were based on a five-year quality assured meteorological data set from the H-area meteorological tower for the period 1997-2001. The data set is input as a joint frequency distribution of wind direction sector and wind speed category by atmospheric stability class (**Table A-24**). The topography data set, consisting of ground elevation for discrete downwind distance by wind direction sector, is summarized in **Table A-25**. Additional inputs to POPDOSE-SR are summarized in **Table 26**.

Table A-24 - Terrain Heights (m) as a Function of Direction and Distance from the Site

Distance (m)	DIRECTION															
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
1609.3	11	11	11	11	11	11	11	7.6	3.7	3.7	3.7	3.7	3.7	11	11	11
3218.7	11	11	11	11	11	11	11	11	11.3	3.7	11	11	11	11	11	11
4828	11	11	11	11	11	11	11	11.3	17.1	14.9	12.5	12.2	11	11	11	11
6437.4	23.2	11	11	11	13.4	29.3	28	14.3	17.1	14.9	12.8	14.6	11	11	11	23.2
8046.8	23.2	11	11	11	18.3	34.4	36.9	26.5	17.1	19.8	14.6	15.5	11	11	11	23.2
9656.1	23.2	11	11	11	26.2	34.4	41.7	28.9	20.1	26.2	15.5	18	15.8	11	11	23.2
11265.5	23.2	11	11	11.6	28	41.4	56.7	33.2	32.3	34.1	31.7	20.1	16.8	11	11	23.2
12874.8	23.2	11	11	11.6	30.5	41.4	59.7	45.4	32.3	41.4	36.9	22.5	16.8	11	11	23.2
14484.1	23.2	11	11	11.6	30.5	41.4	59.7	52.1	32.3	41.4	41.4	26.2	16.8	11	11	23.2
16093.5	23.2	11	11	11.6	30.5	44.5	59.7	56.7	41.4	44.5	42	26.2	16.8	11	11	23.2
19312.2	23.2	11	11	11.6	30.5	44.5	59.7	66.7	41.4	46.3	42	34.4	16.8	11	11	23.2
22530.9	23.2	11	11	11.6	30.5	44.5	61.9	71.9	64.3	53.9	42	34.4	21.6	11	11	23.2
25749.6	23.2	11	11	11.6	30.5	46.3	64	81.1	71.9	53.9	42	34.4	21.6	11	11	23.2
28968.3	23.2	11	11	11.6	30.5	50.3	71.9	82	71.9	56.7	42	34.4	21.6	11	11	23.2
32187	23.2	11	11	11.6	30.5	50.3	71.9	84.1	71.9	56.7	42	34.4	21.6	11	11	23.2
40233.7	23.2	11	11	26.2	41.4	56.7	78	87.8	90.2	71.9	56.7	34.4	21.6	11	11	23.2
48280.5	23.2	11	26.2	26.2	50.6	71.9	102.4	105.4	90.2	81.1	67.3	34.4	21.6	11	11	23.2
56327.2	23.2	26.2	32.3	36.6	78	84.1	102.4	123.7	114.6	81.1	67.3	34.4	21.6	11	11	23.2
64374	23.2	26.2	41.4	53.6	78	84.1	102.4	123.7	120.7	95.7	71.9	34.4	21.6	11	11	23.2
72420.7	23.2	26.2	41.4	53.6	81.1	84.1	102.4	123.7	126.8	117.6	84.1	41.4	21.6	11	11	23.2
80467.5	23.2	26.2	41.4	54.8	82	102.4	102.4	123.7	126.8	117.6	84.1	41.4	21.6	11	11	23.2

Table A-25 - POPDOSE-SR Meteorological Joint Frequency Distributions

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION											ATMOSPHERIC STABILITY CLASS A							
UMX-M/S	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	
2.00	0.413	0.443	0.349	0.411	0.397	0.415		0.397	0.315	0.351	0.354	0.383	0.500	0.495	0.459	0.406	0.415	6.503
4.00	0.988	0.988	0.940	1.120	0.990	0.904	0.602	0.541	0.710	0.858	1.091	1.716	1.399	0.993	0.591	0.739	15.170	
6.00	0.465	0.345	0.276	0.269	0.226	0.164	0.114	0.094	0.183	0.194	0.329	0.552	0.486	0.333	0.146	0.187	4.363	
8.00	0.059	0.066	0.007	0.007	0.009	0.000	0.009	0.005	0.021	0.011	0.034	0.050	0.062	0.052	0.011	0.030	0.434	
12.00	0.016	0.002	0.000	0.002	0.002	0.002	0.000	0.002	0.002	0.005	0.002	0.009	0.002	0.002	0.000	0.002	0.052	
14.10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
TOTAL		1.94	1.84	1.57	1.81	1.62	1.49	1.12	0.96	1.27	1.42	1.84	2.83	2.44	1.84	1.15	1.37	26.52
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION											ATMOSPHERIC STABILITY CLASS B							
UMX-M/S	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	
2.00	0.089	0.084	0.105	0.089	0.062	0.050	0.043	0.039	0.050	0.032	0.064	0.052	0.068	0.082	0.052	0.050	1.013	
4.00	0.497	0.523	0.532	0.628	0.438	0.265	0.224	0.214	0.299	0.322	0.500	0.739	0.481	0.420	0.210	0.244	6.535	
6.00	0.363	0.399	0.356	0.440	0.251	0.176	0.098	0.135	0.185	0.274	0.443	0.689	0.591	0.292	0.128	0.110	4.929	
8.00	0.062	0.116	0.034	0.062	0.014	0.016	0.011	0.021	0.025	0.023	0.148	0.326	0.374	0.237	0.023	0.025	1.517	
12.00	0.009	0.014	0.000	0.007	0.009	0.000	0.000	0.002	0.005	0.007	0.030	0.030	0.114	0.087	0.023	0.016	0.351	
14.10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.002	0.005	
TOTAL		1.02	1.14	1.03	1.23	0.77	0.51	0.38	0.41	0.56	0.66	1.18	1.84	1.63	1.12	0.44	0.45	14.35
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION											ATMOSPHERIC STABILITY CLASS C							
UMX-M/S	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	
2.00	0.048	0.087	0.075	0.046	0.043	0.032	0.052	0.052	0.037	0.041	0.078	0.052	0.043	0.048	0.034	0.052	0.821	
4.00	0.345	0.548	1.013	0.833	0.552	0.411	0.388	0.265	0.488	0.520	0.641	0.730	0.630	0.520	0.292	0.228	8.404	
6.00	0.171	0.554	1.125	0.707	0.392	0.317	0.361	0.290	0.497	0.465	0.632	0.842	0.735	0.534	0.180	0.098	7.902	
8.00	0.005	0.121	0.121	0.128	0.055	0.059	0.064	0.135	0.155	0.121	0.203	0.276	0.354	0.331	0.128	0.034	2.289	
12.00	0.000	0.032	0.009	0.009	0.005	0.007	0.005	0.025	0.025	0.043	0.048	0.037	0.096	0.112	0.023	0.000	0.475	
14.10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.002	
TOTAL		0.57	1.34	2.34	1.72	1.05	0.83	0.87	0.77	1.20	1.19	1.60	1.94	1.86	1.55	0.66	0.41	19.89
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION											ATMOSPHERIC STABILITY CLASS D							
UMX-M/S	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	
2.00	0.023	0.037	0.057	0.039	0.025	0.025	0.068	0.066	0.039	0.034	0.021	0.052	0.030	0.030	0.062	0.032	0.639	
4.00	0.126	0.463	0.906	0.678	0.545	0.491	0.502	0.516	0.821	0.742	0.808	0.794	0.671	0.621	0.472	0.294	9.449	
6.00	0.096	0.477	0.778	0.637	0.616	0.486	0.680	1.088	1.387	0.899	0.974	0.867	0.787	0.612	0.265	0.096	10.745	
8.00	0.000	0.014	0.005	0.009	0.007	0.009	0.025	0.139	0.146	0.048	0.075	0.025	0.014	0.016	0.021	0.002	0.554	
12.00	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.007	0.005	0.002	0.005	0.000	0.005	0.000	0.002	0.000	0.027	
14.10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0. 000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
TOTAL	0.24	0.99	1.75	1.36	1.19	1.01	1.28	1.82	2.40	1.73	1.88	1.74	1.51	1.28	0.82	0.42	21.42	
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION											ATMOSPHERIC STABILITY CLASS E							
UMX-M/S	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	
2.00	0.002	0.014	0.014	0.000	0.007	0.009	0.018	0.016	0.018	0.007	0.014	0.005	0.016	0.007	0.007	0.021	0.173	
4.00	0.027	0.299	0.593	0.306	0.276	0.345	0.349	0.511	0.589	0.573	0.554	0.468	0.324	0.338	0.303	0.288	6.143	
6.00	0.043	0.643	0.434	0.586	0.509	0.570	0.452	0.689	0.931	0.929	0.958	0.853	0.461	0.342	0.180	0.105	8.687	
8.00	0.000	0.018	0.005	0.009	0.007	0.009	0.000	0.005	0.030	0.009	0.016	0.002	0.002	0.005	0.002	0.000	0.119	
12.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0. 000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0. 000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.07	0.97	1.05	0.90	0.80	0.93	0.82	1.22	1.57	1.52	1.54	1.33	0.80	0.69	0.49	0.41	15.12	
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION											ATMOSPHERIC STABILITY CLASS F							
UMX-M/S	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	
2.00	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.009	
4.00	0.011	0.073	0.080	0.014	0.030	0.068	0.059	0.091	0.105	0.037	0.075	0.075	0.023	0.041	0.050	0.032	0.865	
6.00	0.037	0.237	0.064	0.048	0.062	0.219	0.078	0.128	0.132	0.151	0.132	0.130	0.066	0.057	0.071	0.034	1.645	
8.00	0.002	0.011	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.023	
12.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0. 000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0. 000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.05	0.32	0.14	0.06	0.09	0.29	0.14	0.22	0.24	0.19	0.21	0.21	0.09	0.10	0.12	0.07	2.54	
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION											ATMOSPHERIC STABILITY CLASS G							
UMX-M/S	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	
2.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0. 000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.00	0.000	0.005	0.000	0.000	0.000	0.007	0.007	0.005	0.005	0.002	0.009	0.005	0.000	0.002	0.005	0.007	0.057	
6.00	0.011	0.018	0.002	0.000	0.002	0.011	0.014	0.009	0.000	0.002	0.000	0.005	0.007	0.009	0.007	0.000	0.098	
8.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0. 000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0. 000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0. 000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL		0.01	0.02	0.00	0.00	0.00	0.02	0.02	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.16

Table A-26 - Long Term Atmospheric Dispersion Input Parameters	
Parameter	Input Value
Number of Release Points	1
Operating Period	1
Grade Elevation	0
Release Coordinates	76337 E, 76381 N
Met Tower	H
Vent Avg. Air Velocity	0
Vent Inside Diameter	0
Vent Height	0
Height of Vent's Building	0
Min. Vertical X-Section	0
Selected Wind Height	10
Heat Emission Rate	0

Annual average χ/Q and D/Q values for the 16 radial sectors to a distance of 50 miles (80 km) from the SRS are provided in **Tables 27 and 28**, respectively.

Table A-27. Annual Average Relative Air Concentrations (χ/Q in sec/m^3)

	Distance from the Site (mi)										
Sector	**0.25**	**0.5**	**0.75**	**1**	**1.5**	**2**	**2.5**	**3**	**3.5**	**4**	**4.5**
S	2.98E-06	6.99E-07	3.07E-07	1.78E-07	8.92E-08	5.56E-08	3.88E-08	2.92E-08	2.30E-08	1.88E-08	1.57E-08
SSW	8.46E-06	2.30E-06	1.09E-06	6.58E-07	3.36E-07	2.12E-07	1.50E-07	1.13E-07	8.93E-08	7.30E-08	6.12E-08
SW	1.01E-05	2.79E-06	1.33E-06	8.03E-07	4.07E-07	2.55E-07	1.78E-07	1.34E-07	1.05E-07	8.54E-08	7.12E-08
WSW	7.81E-06	2.10E-06	9.91E-07	5.94E-07	3.00E-07	1.88E-07	1.31E-07	9.83E-08	7.72E-08	6.28E-08	5.24E-08
W	6.61E-06	1.78E-06	8.44E-07	5.09E-07	2.59E-07	1.63E-07	1.15E-07	8.64E-08	6.81E-08	5.56E-08	4.65E-08
WNW	7.35E-06	2.02E-06	9.66E-07	5.86E-07	3.02E-07	1.92E-07	1.36E-07	1.03E-07	8.17E-08	6.70E-08	5.63E-08
NW	6.98E-06	1.93E-06	9.26E-07	5.62E-07	2.89E-07	1.83E-07	1.29E-07	9.74E-08	7.70E-08	6.30E-08	5.28E-08
NNW	8.70E-06	2.46E-06	1.19E-06	7.27E-07	3.75E-07	2.37E-07	1.68E-07	1.27E-07	1.00E-07	8.22E-08	6.89E-08
N	1.10E-05	3.09E-06	1.50E-06	9.13E-07	4.70E-07	2.97E-07	2.10E-07	1.58E-07	1.25E-07	1.02E-07	8.58E-08
NNE	9.63E-06	2.69E-06	1.30E-06	7.92E-07	4.07E-07	2.57E-07	1.81E-07	1.37E-07	1.08E-07	8.85E-08	7.42E-08
NE	1.09E-05	3.01E-06	1.45E-06	8.76E-07	4.48E-07	2.82E-07	1.99E-07	1.50E-07	1.18E-07	9.67E-08	8.09E-08
ENE	1.09E-05	2.95E-06	1.40E-06	8.44E-07	4.30E-07	2.71E-07	1.90E-07	1.43E-07	1.13E-07	9.23E-08	7.73E-08
E	8.22E-06	2.18E-06	1.03E-06	6.15E-07	3.12E-07	1.96E-07	1.37E-07	1.03E-07	8.11E-08	6.60E-08	5.52E-08
ESE	7.15E-06	1.91E-06	9.02E-07	5.42E-07	2.76E-07	1.73E-07	1.21E-07	9.13E-08	7.19E-08	5.86E-08	4.90E-08
SE	5.17E-06	1.40E-06	6.65E-07	4.02E-07	2.07E-07	1.31E-07	9.23E-08	6.98E-08	5.52E-08	4.52E-08	3.79E-08
SSE	4.20E-06	1.11E-06	5.20E-07	3.13E-07	1.61E-07	1.02E-07	7.24E-08	5.48E-08	4.35E-08	3.57E-08	3.00E-08

Table A-27. Annual Average Relative Air Concentrations (□/Q in sec/m^3), continued

	Distance from the Site (mi)										
Sector	**5**	**7.5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**
S	1.35E-08	7.84E-09	5.38E-09	3.24E-09	2.31E-09	1.79E-09	1.45E-09	1.22E-09	1.05E-09	9.16E-10	8.14E-10
SSW	5.24E-08	2.93E-08	1.96E-08	1.12E-08	7.70E-09	5.76E-09	4.55E-09	3.74E-09	3.15E-09	2.71E-09	2.38E-09
SW	6.07E-08	3.33E-08	2.20E-08	1.24E-08	8.42E-09	6.25E-09	4.92E-09	4.02E-09	3.38E-09	2.90E-09	2.53E-09
WSW	4.47E-08	2.47E-08	1.63E-08	9.29E-09	6.34E-09	4.74E-09	3.74E-09	3.06E-09	2.58E-09	2.22E-09	1.95E-09
W	3.98E-08	2.21E-08	1.47E-08	8.36E-09	5.70E-09	4.25E-09	3.35E-09	2.74E-09	2.31E-09	1.98E-09	1.73E-09
WNW	4.83E-08	2.70E-08	1.80E-08	1.03E-08	7.04E-09	5.24E-09	4.13E-09	3.38E-09	2.84E-09	2.44E-09	2.13E-09
NW	4.52E-08	2.51E-08	1.66E-08	9.43E-09	6.39E-09	4.74E-09	3.72E-09	3.03E-09	2.55E-09	2.18E-09	1.90E-09
NNW	5.90E-08	3.27E-08	2.16E-08	1.22E-08	8.24E-09	6.08E-09	4.75E-09	3.86E-09	3.23E-09	2.76E-09	2.40E-09
N	7.34E-08	4.06E-08	2.68E-08	1.51E-08	1.02E-08	7.52E-09	5.88E-09	4.77E-09	3.99E-09	3.41E-09	2.97E-09
NNE	6.35E-08	3.51E-08	2.33E-08	1.32E-08	8.88E-09	6.57E-09	5.14E-09	4.19E-09	3.51E-09	3.00E-09	2.61E-09
NE	6.92E-08	3.84E-08	2.54E-08	1.44E-08	9.78E-09	7.26E-09	5.70E-09	4.65E-09	3.90E-09	3.35E-09	2.92E-09
ENE	6.61E-08	3.68E-08	2.45E-08	1.40E-08	9.54E-09	7.12E-09	5.62E-09	4.60E-09	3.88E-09	3.33E-09	2.92E-09
E	4.72E-08	2.62E-08	1.74E-08	9.95E-09	6.81E-09	5.09E-09	4.03E-09	3.31E-09	2.79E-09	2.41E-09	2.11E-09
ESE	4.19E-08	2.33E-08	1.54E-08	8.82E-09	6.03E-09	4.51E-09	3.56E-09	2.92E-09	2.46E-09	2.12E-09	1.86E-09
SE	3.25E-08	1.81E-08	1.21E-08	6.89E-09	4.69E-09	3.49E-09	2.75E-09	2.25E-09	1.90E-09	1.63E-09	1.42E-09
SSE	2.57E-08	1.45E-08	9.74E-09	5.63E-09	3.87E-09	2.90E-09	2.30E-09	1.89E-09	1.60E-09	1.38E-09	1.21E-09

Table A-28. Relative Deposition per Unit Area (m^{-2}) at Fixed Points by Downwind Sectors

Direction From	Distance in Miles from the Site										
	0.25	0.5	0.75	1	1.5	2	2.5	3	3.5	4	4.5
S	2.26E-08	7.65E-09	3.93E-09	2.41E-09	1.20E-09	7.30E-10	4.93E-10	3.57E-10	2.72E-10	2.14E-10	1.73E-10
SSW	3.84E-08	1.30E-08	6.67E-09	4.09E-09	2.04E-09	1.24E-09	8.37E-10	6.06E-10	4.61E-10	3.63E-10	2.94E-10
SW	4.56E-08	1.54E-08	7.92E-09	4.86E-09	2.42E-09	1.47E-09	9.94E-10	7.21E-10	5.48E-10	4.32E-10	3.49E-10
WSW	4.10E-08	1.39E-08	7.12E-09	4.37E-09	2.18E-09	1.32E-09	8.94E-10	6.48E-10	4.93E-10	3.88E-10	3.14E-10
W	3.20E-08	1.08E-08	5.56E-09	3.41E-09	1.70E-09	1.03E-09	6.98E-10	5.06E-10	3.85E-10	3.03E-10	2.45E-10
WNW	2.94E-08	9.94E-09	5.10E-09	3.13E-09	1.56E-09	9.48E-10	6.41E-10	4.64E-10	3.53E-10	2.78E-10	2.25E-10
NW	2.68E-08	9.05E-09	4.65E-09	2.85E-09	1.42E-09	8.63E-10	5.83E-10	4.23E-10	3.21E-10	2.53E-10	2.05E-10
NNW	3.13E-08	1.06E-08	5.43E-09	3.34E-09	1.66E-09	1.01E-09	6.82E-10	4.94E-10	3.76E-10	2.96E-10	2.40E-10
N	4.19E-08	1.42E-08	7.28E-09	4.47E-09	2.23E-09	1.35E-09	9.14E-10	6.63E-10	5.04E-10	3.97E-10	3.21E-10
NNE	3.88E-08	1.31E-08	6.74E-09	4.14E-09	2.06E-09	1.25E-09	8.46E-10	6.13E-10	4.66E-10	3.67E-10	2.97E-10
NE	4.79E-08	1.62E-08	8.31E-09	5.10E-09	2.54E-09	1.54E-09	1.04E-09	7.56E-10	5.75E-10	4.53E-10	3.67E-10
ENE	5.72E-08	1.93E-08	9.94E-09	6.10E-09	3.04E-09	1.84E-09	1.25E-09	9.04E-10	6.87E-10	5.41E-10	4.38E-10
E	4.83E-08	1.63E-08	8.38E-09	5.15E-09	2.57E-09	1.56E-09	1.05E-09	7.63E-10	5.80E-10	4.57E-10	3.70E-10
ESE	3.81E-08	1.29E-08	6.62E-09	4.06E-09	2.03E-09	1.23E-09	8.31E-10	6.02E-10	4.58E-10	3.61E-10	2.92E-10
SE	2.14E-08	7.23E-09	3.71E-09	2.28E-09	1.14E-09	6.90E-10	4.66E-10	3.38E-10	2.57E-10	2.02E-10	1.64E-10
SSE	1.82E-08	6.16E-09	3.16E-09	1.94E-09	9.68E-10	5.87E-10	3.97E-10	2.88E-10	2.19E-10	1.72E-10	1.40E-10

Table 28. Relative Deposition per Unit Area (m^{-2}) at Fixed Points by Downwind Sectors, continued

Direction From	Distance in Miles from the Site										
	5	7.5	10	15	20	25	30	3.50E+01	4.00E+01	4.50E+01	5.00E+01
S	1.43E-10	7.03E-11	4.41E-11	2.23E-11	1.35E-11	9.04E-12	6.48E-12	4.87E-12	3.78E-12	3.02E-12	2.47E-12
SSW	2.43E-10	1.19E-10	7.48E-11	3.78E-11	2.29E-11	1.53E-11	1.10E-11	8.25E-12	6.42E-12	5.13E-12	4.18E-12
SW	2.89E-10	1.42E-10	8.89E-11	4.49E-11	2.72E-11	1.82E-11	1.31E-11	9.81E-12	7.63E-12	6.09E-12	4.97E-12
WSW	2.60E-10	1.27E-10	7.99E-11	4.04E-11	2.44E-11	1.64E-11	1.17E-11	8.82E-12	6.86E-12	5.48E-12	4.47E-12
W	2.03E-10	9.94E-11	6.24E-11	3.15E-11	1.91E-11	1.28E-11	9.17E-12	6.89E-12	5.35E-12	4.28E-12	3.49E-12
WNW	1.86E-10	9.13E-11	5.73E-11	2.89E-11	1.75E-11	1.17E-11	8.42E-12	6.32E-12	4.91E-12	3.93E-12	3.20E-12
NW	1.70E-10	8.31E-11	5.21E-11	2.64E-11	1.60E-11	1.07E-11	7.66E-12	5.76E-12	4.47E-12	3.57E-12	2.92E-12
NNW	1.98E-10	9.71E-11	6.10E-11	3.08E-11	1.86E-11	1.25E-11	8.96E-12	6.73E-12	5.23E-12	4.18E-12	3.41E-12
N	2.66E-10	1.30E-10	8.17E-11	4.13E-11	2.50E-11	1.68E-11	1.20E-11	9.02E-12	7.01E-12	5.60E-12	4.57E-12
NNE	2.46E-10	1.21E-10	7.56E-11	3.82E-11	2.31E-11	1.55E-11	1.11E-11	8.35E-12	6.49E-12	5.18E-12	4.23E-12
NE	3.03E-10	1.49E-10	9.33E-11	4.71E-11	2.85E-11	1.91E-11	1.37E-11	1.03E-11	8.00E-12	6.39E-12	5.22E-12
ENE	3.63E-10	1.78E-10	1.11E-10	5.63E-11	3.41E-11	2.29E-11	1.64E-11	1.23E-11	9.57E-12	7.64E-12	6.24E-12
E	3.06E-10	1.50E-10	9.41E-11	4.76E-11	2.88E-11	1.93E-11	1.38E-11	1.04E-11	8.07E-12	6.45E-12	5.26E-12
ESE	2.42E-10	1.18E-10	7.43E-11	3.75E-11	2.27E-11	1.52E-11	1.09E-11	8.20E-12	6.37E-12	5.09E-12	4.15E-12
SE	1.36E-10	6.64E-11	4.17E-11	2.11E-11	1.27E-11	8.55E-12	6.12E-12	4.60E-12	3.58E-12	2.86E-12	2.33E-12
SSE	1.15E-10	5.66E-11	3.55E-11	1.79E-11	1.09E-11	7.28E-12	5.22E-12	3.92E-12	3.05E-12	2.43E-12	1.99E-12

1.1.2.4 Hydrologic Engineering

1.1.2.4.1. Hydrologic Description

1.1.2.4.1.1 Site and facilities

No data available regarding safety-related elevations, structures, exterior accesses, equipment, and systems per hydrologic considerations. See section C.1.2 (Site Characteristics) for topographic map of proposed GNEP site.

1.1.2.4.1.2 Hydrosphere

The Savannah River is the principal surface water system in the SRS region. Three large reservoirs constructed on the Savannah River upstream of Augusta, Georgia (Strom Thurmond, Richard B. Russell, and Hartwell) provide for hydroelectric power, flood control, and recreation. The closest of these reservoirs to SRS is Strom Thurmond (2.51 million acre-feet), which is located approximately 35 miles (65 river miles) upstream of the site. These upstream reservoirs, along with the New Savannah River Bluff Lock and Dam, serve to stabilize stream flow in the vicinity of SRS. Average, annual stream flows at Augusta, Georgia and SRS are 10,200 cubic feet per second (cfs) and 10,419 cfs, respectively. The 7Q10 flow at Augusta is 3,746 cfs (**Table 29**). The Savannah River serves as an industrial and domestic water source to communities both upstream (Augusta, Georgia and North Augusta, South Carolina) and downstream (Beaufort-Jasper Water Authority in South Carolina and Port Wentworth, Georgia) of SRS. Water withdrawn from the river by SRS is currently minimal. Vogtle Electric Generating Plant (across from SRS) withdraws an average of 92 cfs from the river for cooling purposes and returns an average 25 cfs. The Urquhart Steam Generating Station at Beech Island, SC (upstream of SRS) withdraws approximately 261 cfs of once-through cooling water. There are no identified uses of the river for irrigation purposes in either Georgia or South Carolina. Dredging operations have been conducted on the Savannah River by the U.S. Army Corps of Engineers to create a nine-foot navigation channel Savannah to Augusta, Ga (USACOE 1988; Garrett 1988). The Savannah River downstream of Augusta is classified by the State of South Carolina as a Class B waterway suitable for agricultural and industrial use, the propagation of fish, and domestic use (after treatment). Natural discharge patterns on the Savannah River are cyclic. The highest river levels are recorded in the winter and spring, while the lowest river levels are recorded in the summer and fall.

The Savannah River, which forms the western boundary of SRS, receives drainage from five major tributaries which originate on or drain through the SRS. These tributaries are Upper Three Runs Creek (UTR), Fourmile Branch (FMB), Pen Branch, Steel Creek, and Lower Three Runs (LTR) (see **Figure A-1**). There are also two major surface water impoundments on SRS: Par Pond and L Lake. Par Pond, a 2,500 acre reservoir with average depth of 59 feet, was constructed in 1958 to serve as a cooling water reservoir for P- and R-Reactors. A series of pre-cooling ponds (Ponds 2, 5, and C) and interconnecting canals were also constructed to enhance the lake's efficiency as a cooling reservoir. During reactor operations, Par Pond operated as a closed-loop system with the exception of the additions of makeup water from the Savannah River and overflow/seepage to LTR below the earthen dam. In 1964 DOE suspended R-Reactor operations but the lake continued to receive heated cooling water P-Reactor until 1988 (Paller and Wike 1996). Releases from R-Reactor contaminated Par Pond with low levels of radioactive materials (primarily Cs-137). Elevated levels of mercury are also present in Par Pond water, bottom sediments, and biota. Approximately half of this mercury is from Savannah River make up water and the other half is from natural sources. In 1969, DOE stopped pumping river water into Par Pond to allow water levels to fluctuate naturally. Since then, inflows from the watershed and groundwater have maintained Par Pond's level at approximately 200 feet above msl (USDOE 1997).

The proposed GNEP site is located within the UTR watershed. UTR is a large, cool (annual maximum temperature of 79°F), blackwater stream that originates outside the SRS and flows through the site before its confluence with the Savannah River. The stream is approximately 25 miles long, its lower 17 miles flowing through the SRS. UTR receives more groundwater influx than any other SRS surface stream and, as a result, possesses low conductivity, hardness, and pH values. Mean annual flow in UTR in the general vicinity of the proposed GNEP site is approximately 211 cfs. Flow statistics for the Savannah River and UTR are summarized in **Table A-29.**

Table A-29. Flow Summary for the Savannah River and Savannah River Site Streams (values in ft3/second)

	Mean	STD Dev.	7Q10	7-Day Low Flow
Savannah River				
at Augusta, GA	9493	2611	4332	3746
at SRS Boat Dock	----	----	4293	3773
at Hwy 301[a]	10397	2830	4411	3991
at Clyo	12019	3687	5211	4513
Upper Three Runs				
at Hwy 278	105.0	8.0	56.0	55.0
at SRS Road C	211.0	30.0	100.0	86.0
at SRS Road A	245.0	41.0	100.0	84.0
Beaver Dam Creek				
at 400D	81.5	8.7	0.01	18.0
Fourmile Branch				
at SRS Site 7	17.8	5.4	0.58	3.2
Pen Branch				
at SRS Road B	7.5	8.2	0.27	0.22
at SRS Road A-13	210.0	45.0	5.5	8.8
Steel Creek				
at Hattiesville Bridge	160.0	12.3	12.9	12.0
Lower Three Runs				
below Par Pond	38.4	10.4	1.2	0.9
near Snelling, SC	85.8	27.9	16.0	15.0

[a] Eleven years are missing between 1971 and 1982.

Source: Hunter, C. H., Updated Meteorological, and Hydrological Data for Revision 2 of the SRS Generic Safety Analysis Report, SRT-NTS-970265.
Chen, Kou-fu, 7Q10 Flows for SRS Streams, WSRC-RP-96-340, Westinghouse Savannah River Co., Aiken, SC, 1996.

NOTE: The flow data used for computing statistics for the Savannah River and Savannah River Site Streams were based on U. S. Geological Survey stream gage measurements after construction of Thurmond Dam. Values listed for 7-day low flow, ten year recurrence (7Q10) are based on adjusted "natural" flows, i.e. without the effects of cooling water discharges from Savannah River Site reactors.

The proposed GNEP site is located on an upland area which drains to several tributaries of Upper Three Runs. These include Mill Creek to the east, Tinker Creek to the north and McQueen Branch to the west (USGS 1987). There are no industrial discharges in the Mill Creek and Tinker Creek drainage areas. McQueen's Branch receives stormwater runoff from Z-Area of SRS. The upper reaches of several ephemeral third-order streams are near the eastern and western boundaries of the proposed GNEP site. The locations of these surface streams relative to the proposed GNEP site are illustrated in **Figure A-2**.

1.1.2.4.2 Floods

1.1.2.4.2.1 Flood History

All flood data presented in this section resulted from excess precipitation and associated creek or stream flooding. There have been no floods caused by surge, seiche, dam failure, or ice jams. Annual maximum daily flows for the Savannah River are presented in **Table 30**. Historical records span from 1796 to 2005. Since Strom Thurmond Dam was constructed, no major flood has occurred at Augusta, GA. The United States Army Corps of Engineers (USACE 1996) simulated the October 3, 1929 storm event using current control requirements. The unregulated peak flow of 350,000 cfs resulted in a regulated peak flood flow of 252,000 cfs at Augusta, Georgia.

Table A-30 - Annual Maximum Instantaneous Discharges of the Savannah River at Augusta, Georgia, for Water Years 1921 Through 2005 (USGS Flow Data, 1921-2005)

Water Year	Discharge (cfs)	Water Year	Discharge (cfs)	Water Year	Discharge (cfs)
1921	129,000	1951	41,400	1981	17,700
1922	92,000	1952	39,300	1982	30,700
1923	59,700	1953	35,200	1983	66,100
1924	59,700	1954	25,500	1984	34,000
1925	150,000	1955	23,900	1985	25,700
1926	55,300	1956	18,600	1986	21,000
1927	39,000	1957	18,000	1987	29,200
1928	226,000	1958	66,300	1988	13,600
1929	343,000	1959	28,500	1989	20,200
1930	350,000	1960	34,900	1990	35,300
1931	26,100	1961	34,800	1991	59,200
1932	93,800	1962	32,500	1992	22,100
1933	92,600	1963	31,300	1993	45,100
1934	73,200	1964	87,100	1994	40,700
1935	63,700	1965	34,600	1995	33,600
1936	258,000	1966	39,300	1996	34,400
1937	91,400	1967	26,500	1997	26,300
1938	91,400	1968	35,900	1998	43,000
1939	90,900	1969	45,600	1999	19,000
1940	239,000	1970	25,200	2000	16,800
1941	53,300	1971	63,900	2001	17,600
1942	105,000	1972	33,700	2002	8,510
1943	117,000	1973	40,200	2003	31,600
1944	128,000	1974	32,900	2004	17,600
1945	64,000	1975	45,600	2005	33,700
1946	97,200	1976	33,300		
1947	86,000	1977	34,200		
1948	154,000	1978	43,100		
1949	172,000	1979	37,300		
1950	46,300	1980	47,200		

Source: http://waterdata.usgs.gov/ga/nwis/sw/

***Note**: Station 02197000; drainage area 7,508 square miles (including Butler Creek drainage area). The maximum instantaneous discharge since gaging by the USGS began in 1882 is 350,000 cfs on October 2, 1929. The maximum historical flow is 360,000 cfs in 1796.*

A statistical analysis of Savannah River annual maximum flows downstream at Augusta, GA, was conducted using the Log Pearson Type III distribution as described by Linsley et al. (1982). For the 50-year period from 1956 to 2005, after construction of Strom Thurmond Dam, the mean annual maximum flow, based on instantaneous peak flow, was 34,300 cfs, the 10-year maximum flow was 54,000 cfs, and the estimated 50-year maximum flow was 71,100 cfs.

The annual instantaneous maximum flows for UTR gauging stations at Highway 278 near SRS Road C and at SRS Road A are listed in **Table 31.** An analysis of annual maximum floods of the three UTR gauging stations, based on instantaneous peak flow, was conducted using the Log Pearson Type III distribution. Records for UTR at Road C for water years 1975 through 2002 (excluding 1998 and 1999) show the following:

- The mean annual maximum flow was 816 cfs.
- The 10-year maximum flow was 1,237 cfs.
- The estimated 50-year maximum flow was 1,763 cfs.

1.1.2.4.2.2 Flood Design Considerations

All safety-related structures associated with the proposed GNEP project would be located on topographic high points and not threatened by flood water. The calculated Probable Maximum Flood (PMF) water level for the Savannah River at the Vogtle Electric Generating Plant (VEGP) site is 118 feet above msl without wave run-up (GPC 1987). Minimum plant grade at the proposed GNEP site (approximately 300 feet above msl) would be well above this flood stage.

1.1.2.4.2.3 Effects of Local Intense Precipitation

Flood design considerations are described below in reference to specific local facilities. The descriptions are based on available information.

Unusually intense local rainfalls occurred on the SRS on July 25, 1990; August 22, 1990; October 10-12, 1990; and October 22-23, 1990. A report on these unusual rainfalls was prepared by the Environmental Transport Group of SRNL (Addis and Kurzeja 1990). The report concluded that although over 6 inches of rain fell in a 10 square mile area during the August 22 storm, this amount is just 20% of the 6-hour probable maximum precipitation (PMP) of 31.0 inches. The 6-hour cumulative PMP for a 10-square-mile area surrounding H-, S-, and Z-Areas near the proposed GNEP site is 31 inches (**Table 32**) (Schreiner and Riedel 1978). This rainfall was adjusted to a point PMP, as shown by Hansen and others and used to generate the PMF for the small watershed of Crouch Branch near the GNEP site (Hansen et al. 1982). A synthetiKurc hydrograph was used to determine peak flow (USNRC 1997). The peak stage corresponding to the PMF is 224.5 feet above msl or 83 feet below the area grades.

Table 32. Cumulative Probable Maximum Precipitation for a 10-Square-Mile Area Surrounding the H, S, Z, and M-Areas

Time (hr)	Incremental Rainfall (in.)	Total Rainfall (in.)
0	–	0
1	2.2	2.2
2	2.8	5
3	3.1	8.1
4	15.1	23.2
5	4.9	28.1
6	2.7	30.8

Source: U. S. Dept. of Commerce, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian, Hydrometeorological Report No. 51, Washington, DC, (1978).

Table A-31 - Annual Maximum Instantaneous Discharges of UpperThree Runs Creek for Water Years 1967 Through 2002

Water Year	Discharge at Highway 278[a] (cfs)	Discharge at SRS Road C[b] (cfs)	Discharge at SRS Road A[c] (cfs)
1967	320	-	-
1968	237	-	-
1969	301	-	-
1970	303	-	-
1971	420	-	-
1972	372	-	--
1973	472	-	
1974	260	-	-
1975	341	700	626
1976	429	1010	1230
1977	304	613	717
1978	344	850	-
1979	341	950	730
1980	400	880	951
1981	308	582	620
1982	364	696	793
1983	331	641	1010
1984	466	840	861
1985	400	962	893
1986	360	802	780
1987	370	891	869
1988	278	460	428
1989	301	613	592
1990	202	869	572
1991	820	2040	Unknown
1992	742	1010	926
1993	421	1280	-
1994	302	826	667
1995	412	1240	1010
1996	240	519	638
1997	242	565	709
1998	596	-	1200
1999	252	-	717
2000	291	539	645
2001	296	473	460
2002	164	381	394

Source: http://waterdata.usgs.gov/sc/nwis/sw/

[a]Station 02197300; drainage area 87 square miles.
[b]Station 02197310; drainage area 176 square miles.
[c]Station 02197315; drainage area 203 square miles.

1.1.2.4.4 Potential Dam Failures (Seismically Induced)

The only significant dams or impoundment structures that could affect the safety of SRS are large U.S. Army Corps of Engineers dams on the Savannah River upstream of Augusta, GA.

1.1.2.4.4.1 Dam Failure Permutations

A domino failure of the dams on the Savannah River and its tributaries upstream of VEGP was analyzed in the VEGP Final SAR (GPC 1987). Using conservative assumptions, this worst dam failure scenario would yield a peak flow of 2,400,000 cfs at the Strom Thurmond Dam. This rate, undiminished in magnitude, was transferred to below Augusta, GA. However, because of the great width of the flood plain, routing of the dam failure surge to the VEGP site (River Mile 151) resulted in a peak discharge of 980,000 cfs, with a corresponding stage of 141 feet above msl. Minimum elevation at the proposed GNEP site is approximately 300 feet above msl.

1.1.2.4.4.2 Unsteady Flow analysis of Potential Dam Failures

No dams are located near SRS areas, including the proposed GNEP site. Therefore, this section does not apply.

1.1.2.4.4.3 Water Level at the Plant Site

NA. See Section 1.1.2.4.4.1.

1.I.2.4.5 Probable Maximum Surge and Seiche Flooding

No large water bodies exist near the site; therefore, this section does not apply. Run-up of flood waters from the worst combination of wind and waves on the Savannah River is not a hazard at the proposed GNEP site because the peak flood elevation is well below minimum plant grade, and the maximum wave under the worst circumstances is less than three feet.

1.I.2.4.6 Probable Maximum Tsunami Flooding

Savannah River Site is more than 140 river mile inland from the coastal city of Savannah, GA. Therefore, the probability of flooding due to Tsunami is extremely low.

1.I.2.4.7 Ice Flooding

Because of regional climatic conditions, the formation of significant amounts of ice on streams and rivers rarely occurs. The Hartwell, Richard B. Russell, and Strom Thurmond dams moderate water temperature extremes, making ice formation on the Savannah River at SRS unlikely. No historical ice flooding has been noted, although ice has, on several occasions, been observed in the Savannah River. Because the proposed GNEP site is so much higher than the nearest surface streams, it is not considered credible that they could be impacted by ice flooding, even if the climatic conditions were conducive to ice formation.

1.1.2.4.8 Cooling Water Canals and Reservoirs

Cooling water cannals and reservoirs are not specifically discussed in this report.

1.1.2.4.9 Channel Diversions

There is no historical record of diversions of streams or rivers within the project area. Outside of precipitation, the only source of water to the site is groundwater. No waterway diversion could flood the site because the site is much higher than the surrounding streams and rivers.

1.1.2.4.10 Flooding Protection Requirements

Because the site is located on a local topographic high, there is no threat to the proposed GNEP site from flooding. Only the pump houses on the Savannah River could be flooded and become inoperative.

1.1.2.4.11 Low Water Considerations

1.1.2.4.11.1 Low Flow in Rivers and Streams

Low flow in the Savannah River adjacent to SRS is regulated by Strom Thurmond Dam and the New Savannah Bluff Lock and Dam. A minimum flow of 5,800 cfs is required for navigation in the river downstream from Strom Thurmond Dam. However, it should be noted that a discharge of 6,300 cfs is normal 80% of the time. A minimum required flow of 4,130 cfs is released from New Savannah Bluff Lock and Dam. The Strom Thurmond Dam project is designed for a maximum drawdown of 18 feet from the top of the power pool elevation of 330 feet msl to a minimum pool at 312 feet msl. However, it is not anticipated that the minimum pool will be reached more often than once in every 150 years. During extreme drought conditions from July 1987 through April 1989, average discharge at Strom Thurmond Dam was cut to 3,600 cfs (USGAO 1989). The reduced discharge lasted from April 1988 to April 1989 and was the minimum flow necessary to maintain water quality criteria for the Savannah River downstream of SRS. River flow at Augusta, GA, however, averaged 4,300 cfs weekly from April 1988 to December 1988 due to higher than normal influx downstream of Thurmond Lake. Discharges from Hartwell and Russell Reservoirs, upstream of Thurmond Lake, were also severely restricted. During this drought period, Thurmond Lake conservation pool elevations decreased substantially, reaching a low point of one foot above minimum pool level in February 1989.

Flow records for Augusta, GA, for the periods 1884 through 1906 and 1926 through 1970 were examined. A hypothetical extreme drought flow of 957 cfs was determined by statistical analysis of 1926 through 1950 flow records. During this period, no major dams were built on the river or its tributaries upstream of Augusta. It is concluded that the hypothetical extreme drought would have a stage elevation of 74 feet msl, which is 6 feet below the minimum required to operate any of the river pumping facilities. From the flow records for the 62 years of examined data from the USGS, it is concluded that a sustained minimum release of 5,800 cfs (the planned operation of Hartwell and Thurmond reservoirs) could have been maintained for this period. A flow of 3,600 cfs at Ellenton Landing is required under present conditions to provide water to the pump intakes.

1.1.2.4.11.2 Low Water Resulting from surges, Seiches or Tsunami – not applicable.

1.1.2.4.11.3 Historical Low Water

The available flow records (62 years) for Augusta, GA, for the periods 1884 through 1906 and 1926 through 1970 were examined. The low flow of record for gauging station 02197000, on the Savannah River at New Savannah Bluff Lock and Dam (river mile 189.8) near Augusta, GA, before construction of Strom Thurmond Dam, occurred on September 24, 1939. This was caused by the operation of the gates at New Savannah River Lock and Dam. If the rating curve is extended below 1,400 cfs, an extreme minimum discharge of 648 cfs is reached. This is an extrapolated instantaneous minimum. Water stage recorder graphs and discharge measurements were furnished by the Corps of Engineers. On the day this low flow was recorded, the average daily flow was 2,940 cfs. Examination of the hydrograph for this day indicates that the lowest flow occurred for about 10 hours, the daily flow being over 2,000 cfs. The lowest mean daily flow shown in the Augusta record was 1,040 cfs, which occurred on October 2, 1927.

The minimum mean daily discharge for the period 1963 through 1970 (after the filling of both reservoirs) was 5,130 cfs in 1963. The storage for power and navigation releases (between normal and minimum pool levels) from Hartwell and Thurmond Reservoirs was 2,445,000 acre-feet, which would provide an average release of 3,350 cfs for 1 year assuming no inflow. The total storage (between top of gates and minimum pool level) from both reservoirs was 3,128,000 acre-feet, which would provide an average release of 4,300 cfs for 1 year assuming no inflow.

The Savannah River has been gauged at Augusta, GA, for more than a century. More recently (in 1971), a gauging station was established at Jackson, SC. Upper Three Runs has been gauged since 1966 at Highway 278 near New Ellenton, SC, and near SRS Road A, below F-Area. An additional gauging station on UTR was established near SRS Road C in 1974. Since Strom Thurmond Dam was finished in the early 1950s, the river has been regulated by the Corps of Engineers. A minimum daily flow of 4,000 cfs was recorded October 22, 1991.

The minimum daily flow for Upper Three Runs Creek is 49 cfs at Highway 278; 111 cfs near SRS Road A; and 105 cfs near SRS Road C (USGS 1986). Although the period of data recording is short, Upper Three Runs Creek has a smaller range of flow variation than other streams in the area (USGS 1986).

1.1.2.4.11.4 Future Controls

Minimum flow conditions are controlled mainly by upstream dam releases, and no additional users of large amounts of water are anticipated.

*1.1.2.4.11.5 Plant Requirements -*Project-specific data are lacking.

1.1.2.4.11.6 Heat Sink Dependability Requirements - Project-specific data are lacking.

Vibratory ground motion and site specific foundation studies are not discussed in this report.

Appendix 2. Onsite Meteorological Measurement Program

Meteorological data are collected at SRS from a network of nine primary monitoring sites (Fig. 1). Towers located adjacent to each of eight operations areas (A, C, D, F, H, K, L, and P areas) are equipped with a bi-directional wind vanes (bivanes), fast-response cup anemometers, slow-response resistance temperature probes, and lithium chloride dew point sensors at a height of 61 meters (m) above ground. Temperature and dew point are also measured at 2m. A ninth tower near N-Area, known as the Central Climatology site (CLM), is instrumented with identical wind, temperature, and dew point sensors at four levels: 2m (4m for wind), 18m, 36m, and 61m. The CLM site is also equipped with an automated tipping bucket rain gauge, a barometric pressure sensor, and a solar radiometer near the tower at ground level. Data acquisition units at each station record a measurement from each instrument at 1-second intervals. Every 15 minutes, the 1-second data are processed to generate statistical summaries for each variable, including averages and instantaneous maxima, and the results are uploaded to a relational database for permanent archival.

All aspects of the meteorological data collection program (instrumentation, siting, and maintenance and calibration protocols) meet or exceed applicable regulatory criteria, including the DOE Environmental Regulatory Guide DOE/EH-0173T, Safety Guide 23 of the NRC, and the ANS/ANSI Guide 2.5. Parker and Addis (Ref. 25) provide a complete description of the meteorological monitoring program at SRS. Use of the data in real-time emergency response is a primary consideration in the operation of the monitoring network. An adequate supply of spare calibrated instrumentation is maintained so replacement sensors are readily available. All instrumentation is calibrated every 6 months by trained instrument mechanics. A wind tunnel at the Savannah River National Laboratory is available for calibration of the wind sensors. The calibrations are conducted according to manufacturer's specifications using procedures that meet or exceed American Society of Testing and Materials (ASTM) calibration methods.

Quality assurance of the data is conducted in two phases: an initial screening of recent data, followed by an in-depth review and final quality classification. The initial screening, performed twice daily by qualified instrument technicians, consists of a thorough examination of 15-minute data retrieved from the database, in conjunction with a summary of instrument diagnostics obtained from the local data acquisition units. Potential problems are noted in a daily checksheet and, as needed, data acquisition unit software is instructed to assign a quality control tag to data collected from the questionable instruments. Quality tags are also set during periods of calibration and maintenance.

The second phase of the quality assurance process is conducted according to formal procedure (26). Daily checksheets generated during the initial screening, tower-specific logbook entries, initial quality tags, and time series plots of related data are reviewed to determine a final quality status for each record. All records permanently archived in the data base are identified as good, fatal, intermittent, biased, or uncalibrated.

Quality assured data from the data base are subsequently used to construct a five-year record of data suitable for use with air dispersions models used in safety analysis and compliance with air quality regulations. Ref. 27 provides a description of the development of the most recent formal five-year record.

Additional measurements of temperature and relative humidity are recorded from a weather station located in A-Area. This station consists of a standard NWS ‘cotton region’ instrument shelter. Data collected from this station are manually tabulated for archival as daily high and low values of temperature and relative humidity. Tabulated values are then entered into a permanent electronic data base.

Appendix 3. Potential NRC Regulations for the ARR and NFRC.

Applicable NRC siting regulations

The following NRC regulations address key issues potentially required for both the ARR and NFRC:

- 10 CFR 20 Standards for Protection Against Radiation
  - 10 CFR 20.1003
  - 10 CFR 20.106(a)
  - 10 CFR 20.1-20.601
  - 10 CFR 20.1301 Dose Limits for Individual Members of the Public
- 10 CFR 50 Domestic Licensing Of Production and Utilization Facilities
  - 10 CFR 50.34(a)
  - 10 CFR 50.34(f) TMI
  - 10 CFR 50.36(a)
  - 10 CFR 50, Appendix 1, Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as Reasonably Achievable' for Radioactive Materials in Light-Water-Cooled Nuclear Power Reactor Effluents
  - 10 CFR 50, Appendix A, GDC 2, Design Bases for Protection Against Natural Phenomena

The following NRC regulations address key issues potentially required for the ARR:

- 10 CFR 52 Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants
  - 10 CFR 52.47(a)(1)(iii) also .79 and .80
  - 10 CFR 52.79 Contents of Applications: Technical Information
- 10 CFR 100 Reactor Site Criteria
  - 10 CFR 100.21(a)
  - 10 CFR 100.3
  - 10 CFR 100.3(a)

The following NRC regulations address key issues potentially required for the NFRC:

- 10 CFR 30 Rules of general applicability to domestic licensing of byproduct material
- 10 CFR 31 General domestic licenses for byproduct material
- 10 CFR 32 Specific domestic licenses to manufacture or transfer certain items containing byproduct material
- 10 CFR 33 Specific domestic licenses of broad scope for byproduct material
- 10 CFR 51 Environmental protection regulations for domestic licensing and related regulatory functions
- 10 CFR 70 Domestic licensing of special nuclear material
- 10 CFR 71 Packaging and transportation of radioactive material
- 10 CFR 74 Material control and accounting of special nuclear material
- 10 CFR 75 Safeguards on nuclear material-implementation of US/IAEA agreement
- 10 CFR 110 Export and import of nuclear equipment and material

Applicable NRC regulatory guidance

Regulatory Guides, Draft Guides, Policy Statements, and SECY Position Letters

Relevant Regulatory Guides, Draft Guides, Policy Statements, and SECY Position Letters, and associated Regulatory Positions (include date/revision) are as follows:

- DG-1143 (01/2006) for Regulatory Guide 1.76 Design Basis Tornado for Nuclear Power Plants. April, 1974
- Draft Regulatory Guide, DG-1145 (RG1.206), "Combined License Applications for Nuclear Power Plants" (LWR Edition), September 2006.
- DG-1146 A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion (ML063030291) July, 2006.
- NRC Policy Statement, "Severe Reactor Accidents Regarding Future Designs and Existing Plants" [Volume 50, page 32138, of the Federal Register (50 FR 32138), dated August 8, 1985].
- NRC Policy Statement, "Safety Goals for the Operations of Nuclear Power Plants" (51 FR 28044, dated August 4, 1986).
- NRC Policy Statement, "The Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities" (60 FR 42622, dated August 16, 1995).
- Regulatory Guide 1.23 (DG-1164) Onsite Meteorological Programs. February, 1972.
- Regulatory Guide 1.26 (DG-1152) Quality Group Classifications and Standards for Water, Steam-, and Radioactive-Waste Containing Components of Nuclear Power Plants. (November, 2006).
- Regulatory Guide 1.27 Ultimate Heat Sink for Nuclear Power Plants. January, 1976.
- Regulatory Guide 1.29 (DG-1156) Seismic Design Classification. September, 1978.
- Regulatory Guide 1.59 Design Basis Floods for Nuclear Power Plants. August 1977.
- Regulatory Guide 1.60 "Design Response Spectra for Seismic Design of Nuclear Power Plants.
- Regulatory Guide 1.78 Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release. December, 2001.
- Regulatory Guide 1.91 Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants. February, 1978.
- Regulatory Guide 1.97 Instrumentation for Light-Water-Cooled Nuclear Power Plants To Assess Plant and Environs Conditions During and Following an Accident. June, 2006.
- Regulatory Guide 1.111 Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors. July, 1977.
- Regulatory Guide 1.112 (DG-1160) Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors, May, 1977.
- Regulatory Guide 1.132 Site Investigations for Foundations of Nuclear Power Plants. October, 2003.
- Regulatory Guide 1.138, Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants. April, 1978.
- Regulatory Guide 1.143, Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants, November 2001.
- Regulatory Guide 1.145 Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants. November, 1982.
- Regulatory Guide 1.165 Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion. March, 1997.
- Regulatory Guide 1.183 Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors. July, 2000.

- Regulatory Guide 1.194 Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants. June, 2003.
- Regulatory Guide 1.198 Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites, November, 2003.
- Regulatory Guide 1.200 (DG-1161) An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities. February, 2004.
- Regulatory Guide 4.2 Preparation of Environmental Reports for Nuclear Power Stations," Rev. 2, July, 1976.
- Regulatory Guide 4.2S1 Supplement to Regulatory Guide 4.2, Preparation of Supplemental Environmental Reports for Applications to Renew Nuclear Power Plant Operating Licenses, September, 2000.
- Regulatory Guide 4.7 General Site Suitability Criteria for Nuclear Power Stations, Revision 2, April 1998.
- SECY-90-016, "Evolutionary Light-Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements," issued January 12, 1990, and the related staff requirements memorandum (SRM), issued June 26, 1990.
- SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor Designs," issued April 2, 1993, and the related SRM, issued July 21, 1993.
- SECY-96-128, "Policy and Key Technical Issues Pertaining to the Westinghouse AP600 Standardized Passive Reactor Design," issued June 12, 1996, and the related SRM, issued January 15, 1997.
- SECY-97-044, "Policy and Key Technical Issues Pertaining to the Westinghouse AP600 Standardized Passive Reactor Design," issued February 18, 1997, and the related SRM, issued June 30, 1997.
- SECY-06-066, Regulatory and Resource Implications of a Department of Energy Spent Nuclear Fuel Recycling Program, March 22, 2006.

Standard Review Plans (SRPs), Acceptance Criteria, and Branch Technical Positions (BTPs)

Relevant Standard Review Plans (SRPs) and associated Acceptance Criteria, and Branch Technical Positions (BTPs); including date and revision (note: all SRP are 1996 revisions unless otherwise noted):

- SRP 2.0 (under preparation) Site Parameter Envelope.
- SRP 2.1.1 Site Location and Description, Rev. 3.
- SRP 2.1.2 Exclusion Area Authority and Control, Rev. 3.
- SRP 2.1.3 Population Distribution, Rev. 3.
- SRP 2.2.1-2.2.2 Identification of Potential Hazards in Site Vicinity, Rev. 3.
- SRP 2.2.3 Evaluation of Potential Accidents, .Rev. 3
- SRP 2.3.1 Regional Climatology, Rev. 3, November, 2006.
- SRP 2.3.2 Local Meteorology. (Note SRP 3.5.1.4, Missiles Generated By Tornadoes And Extreme Winds, January, 2006.
- SRP 2.3.3 Onsite Meteorological Measurements Programs, Rev. 3, December, 2006.
- SRP 2.3.4 Short Term Dispersion Estimates for Accidental Atmospheric Release, Rev. 3.
- SRP 2.3.5 Long Term Diffusion Estimates, Rev. 3
- SRP 2.4.1 Hydrologic Description, January, 2007.
- SRP 2.4.2 Floods, Rev. 4, January, 2007.
- SRP 2.4.3 Probable Maximum Flood (PMF) on Streams and Rivers, Rev. 4.
- SRP 2.4.4 Potential Dam Failures, Rev. 3.
- SRP 2.4.5 Probable Maximum Surge and Seiche Flooding, Rev. 3.
- SRP 2.4.6 Probable Maximum Tsunami Hazards, Rev. 3, January 2007.
- SRP 2.4.7 Ice Effects, Rev. 3, January, 2007.

- SRP 2.4.8 Cooling Water Canals and Reservoirs, Rev. 3.
- SRP 2.4.9 Channel Diversions, Rev. 3.
- SRP 2.4.10 Flooding Protection Requirements, Rev. 3.
- SRP 2.4.11 Cooling Water Supply, Rev. 3.
- SRP 2.4.12 Groundwater, Rev. 3.
- SRP 2.4.13 Accidental Releases of Liquid Effluents in Ground and Surface Waters, Rev. 3.
- SRP 2.4.14 Technical Specifications and Emergency Operation Requirements, Rev. 3.
- SRP 2.5.1 Basic Geologic and Seismic Information, Rev. 3.
- SRP 2.5.2 Vibratory Ground Motion, Rev. 3.
- SRP 2.5.3 Surface Faulting, Rev. 3.
- SRP 2.5.4 Stability of Subsurface Materials and Foundations, Rev. 3.
- SRP 2.5.5 Stability of Slopes, Rev. 3.
- SRP 3.7.1 Seismic Design Parameters, Rev. 3.
- SRP 3.7.2 Seismic System Analysis, Rev. 3.
- NUREG-0570 Toxic Vapor Concentrations in the Control Room Following a Postulated Accidental Release, Prepared for the U.S. Nuclear Regulatory Commission, June, 1979.
- NUREG – 75/087 Standard Review Plan.
- NUREG-0800 Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, Section 2, March, 2007.
- NUREG-0933 A Prioritization of Generic Safety Issues, November, 2005.
- NUREG-1555 Standard Review Plans for Environmental Review for Nuclear Power Plants, October, 1999.
- NUREG/CR-0075 Accidental Vapor Phase Explosions on Transportation Routes Near Nuclear Power Plants, Final Report, NUREG/CR-0075, January - April 1977.
- NUREG/CR-1748 Hazard to Nuclear Power Plants from Nearby Accidents Involving Hazardous Materials- Preliminary Assessment, Prepared for U.S. Nuclear Regulatory Commission, May 1981.
- NUREG/CR-2252 National Thunderstorm Frequency for the Contiguous United States.
- NUREG/CR-6372 Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts.

Applicable industry codes and standards, and other guidance documents

The following industry codes may be cited relative to detailed siting of the ARR and NFRC:

- American Concrete Institute (ACI), "Building Code Requirements for Structural Concrete" ACI 318-02, January, 2002.
- National Weather Source Publication Hydrometeorology Report No. 52 (HMR-52), April, 1991.
- ASCE Standard 7-02 Minimum Design Loads for Buildings and Other Structures, 2002.
- NFPA Fire Protection Handbook, Sixteenth Edition, National Fire Protection Association (NFPA), Quincy, Massachusetts, 1986.
- NFPA-805 Performance-Based Standard For Fire Protection For Light Water Reactor Electric Generating Plants, 2006.
- NOAA, Technical Report NWS NWS 23, "Meteorological Criteria for Standard Project Hurricane and Probable Maximum Hurricane Windfields, Gulf and East Coasts of the United States," 1979.
- NIST "Computation of the Outflow from a Breached Dam," Report No. 6473, July 31, 1959.
- Active ASTM Standards citied in NRC guidance (most recent versions and ongoing revisions as denoted at www.astm.org, to include internally referenced ASTM standards):

- U.S. Department of the Army Technical Manual TM 5-1300 Structures to Resist the Effects of Accidental Explosions, November, 1990.
- ASCE Standard 43-05, “Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities”, 2005.

NRC Regulations Title 10, Code of Federal Regulations

Part 1	Statement of organization and general information
Part 2	Rules of practice for domestic licensing proceedings and issuance of orders
Part 4	Nondiscrimination in Federally assisted programs or activities receiving Federal financial assistance from the Commission
Part 5	Nondiscrimination on the basis of sex in education programs or activities receiving Federal financial assistance
Part 7	Advisory committees
Part 8	Interpretations
Part 9	Public records
Part 10	Criteria and procedures for determining eligibility for access to restricted data or national security information or an employment clearance
Part 11	Criteria and procedures for determining eligibility for access to or control over special nuclear material
Part 12	Implementation of the Equal Access to Justice Act in agency proceedings
Part 13	Program fraud civil remedies
Part 14	Administrative claims under Federal Tort Claims Act
Part 15	Debt collection procedures
Part 16	Salary offset procedures for collecting debts owed by Federal employees to the Federal government
Part 19	Notices, instructions and reports to workers: inspection and investigations
Part 20	Standards for protection against radiation
Part 21	Reporting of defects and noncompliance
Part 25	Access authorization for licensee personnel
Part 26	Fitness for duty programs
Part 30	Rules of general applicability to domestic licensing of byproduct material
Part 31	General domestic licenses for byproduct material
Part 32	Specific domestic licenses to manufacture or transfer certain items containing byproduct material
Part 33	Specific domestic licenses of broad scope for byproduct material
Part 34	Licenses for industrial radiography and radiation safety requirements for industrial radiographic operations
Part 35	Medical use of byproduct material
Part 36	Licenses and radiation safety requirements for irradiators
Part 39	Licenses and radiation safety requirements for well logging
Part 40	Domestic licensing of source material
Part 50	Domestic licensing of production and utilization facilities
Part 51	Environmental protection regulations for domestic licensing and related regulatory functions
Part 52	Early site permits; standard design certifications; and combined licenses for nuclear power plants
Part 53	[Reserved]
Part 54	Requirements for renewal of operating licenses for nuclear power plants
Part 55	Operator's licenses
Part 60	Disposal of high-level radioactive wastes in geologic repositories
Part 61	Licensing requirements for land disposal of radioactive waste

Part 62	Criteria and procedures for emergency access to non-federal and regional low-level waste disposal facilities
Part 63	Disposal of high-level radioactive wastes in a geologic repository at Yucca Mountain, Nevada
Part 70	Domestic licensing of special nuclear material
Part 71	Packaging and transportation of radioactive material
Part 72	Licensing requirements for the independent storage of spent nuclear fuel, high-level radioactive waste, and reactor-related greater than Class C waste
Part 73	Physical protection of plants and materials
Part 74	Material control and accounting of special nuclear material
Part 75	Safeguards on nuclear material-implementation of US/IAEA agreement
Part 76	Certification of gaseous diffusion plants
Part 81	Standard specifications for the granting of patent licenses
Part 95	Facility security clearance and safeguarding of national security information and restricted data
Part 100	Reactor site criteria
Part 110	Export and import of nuclear equipment and material
Part 140	Financial protection requirements and indemnity agreements
Part 150	Exemptions and continued regulatory authority in Agreement States and in offshore waters under section 274
Part 160	Trespassing on Commission property
Part 170	Fees for facilities, materials, import and export licenses, and other regulatory services under the Atomic Energy Act of 1954, as amended
Part 171	Annual fees for reactor licenses and fuel cycle licenses and materials licenses, including holders of certificates of compliance, registrations, and quality assurance program approvals and government agencies licensed by the NRC
Parts 172-199	[Reserved]

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